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School-Master and Scholar's
MUTUAL ASSISTANT:
OR, A
Compendious System
O F
PRACTICAL ARITHMETIC,
Made perfectly Easy.

CONTAINING
All the useful RULES in WHOLE NUMBERS and
FRACTIONS, both Vulgar and Decimal.

TOGETHER WITH
The EXTRACTION of the SQUARE and CUBE ROOTS.

AND
MENSURATION of ARTIFICERS WORK of all Kinds,
and of SQUARE and ROUND TIMBER.

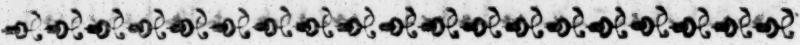
ALSO,
A SKETCH of SURVEYING.

Several of the Questions are left blank, on Purpose to be varied at
Pleasure, which will be found of singular Service to Teachers,
as well as assiduous Pupils.—

The Whole being laid down in the most plain and intelligible
Manner, in order to render the Science as little difficult as
may be, and as easy to be attained as possible by the Youth of
either Sex.

By WILLIAM BANSON,
WRITING-MASTER and ACCOUNTANT.

LONDON: Printed for C. Hitch and L. Hawes, and J. Richard-
son, in Pater-Noster-Row, and W. Bristow in St Paul's Church-
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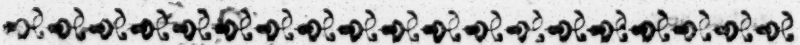
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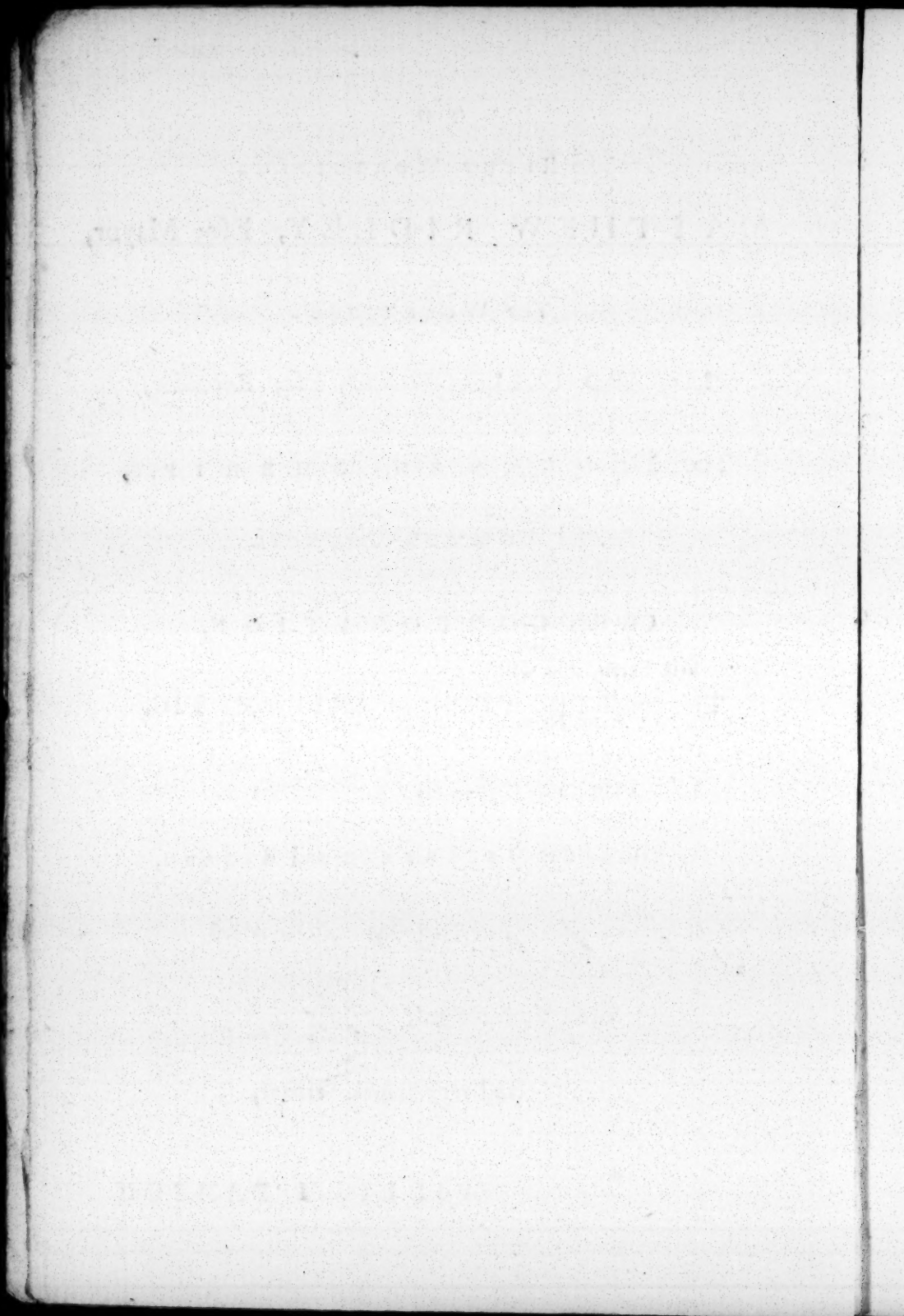
In Testimony of his Gratitude,
Is, with all due DEFERENCE and REGARD,

Inscribed by *John Butler*

Their much obliged,

And very humble Servant,

WILLIAM BANSON.





T H E
P R E F A C E.

THE many Advantages arising from a competent Knowledge of Practical Arithmetic, are so very apparent to every Day's Experience, that to enumerate even but a few of them would be deem'd an unnecessary Undertaking.

Tho' the Title Page may of itself seem a sufficient Explanation of the Author's Design in this Work to the good-natured and impartial.—Yet as several Objections, probably some just ones, may be made to it, he thinks he has a Right to say as much in his own Behalf, by Way of Introduction, as may serve to parry a Blow from an ill-natured, captious or conceited Critic.

A Book of this Sort was published between fifty and sixty Years ago by my Grandfather, entirely for the Use of his own numerous School; and as several Books of much the like Nature, and nearly under the same Title, have appeared of late Years by other Masters, 'tis evident it has been approved of, and found useful.—And tho' some of them may have enlarged his Plan a little—as I apprehend I have a just Right to the original Design, I hope no unprejudiced Person will think it unfair or unreasonable in me to lay Claim to my Privilege, and to avail myself of any little Improvements that have been made upon it.

The Reader will perceive that my principal Design in this Publication was to be more at Leisure in School-Time to ask Questions, and to assist my young Pupils in any Difficulties that may arise: And this good End, the little Treatise before you, will, I am confident, answer to me, and to all who make use of it; as

The P R E F A C E.

a Teacher generally has more Trouble in making a proper Question under most of the Rules (the four first excepted) than in examining two or three. In order to effect this valuable Purpose, the Questions are all, (the first under each Rule excepted) left blank, to be varied and fill'd up at Pleasure, by which Means no one Scholar can learn his Lesson from another, a Practice too common and prejudicial. Care has been taken to lay down the RULES in as plain and intelligible Terms as possible; and they are mostly new modell'd, and very few or none of the short contracting Ways of Working are introduced, but such as are quite clear, plain and intelligible; such Methods being only to be made Use of with Certainty by those who are complete Masters of Figures; besides they are generally more difficult to be understood by young Scholars than the common Rules; and when a Person finds himself Master of Numbers, he will easily contrive how to perform his Work in the shortest Method. The Rule of Practice may indeed be often as readily performed by Multiplication (see p. 30) as by Division, provided the given Number does not exceed 100,—but in that Case the Memory will be put to more Stress than in the common Way by Division. The Instructions shew how the Question wrought under each Rule is performed, Step by Step, in the most easy and familiar Way, so that any Youth of but a tolerable Capacity may as readily instruct himself in all the Principles of Arithmetic by this Book as any other; nay, with more Ease, as nothing will be found superfluous in it, and 'tis hoped, nothing material wanting.

It will also be of great Service to Masters of Families, or others, who chuse to instruct their own Children, Servants, &c. as they will have little more to do than to fill up the Questions, which may be done without much Consideration, with almost any Figures or Numbers they first think of.

*Tho' Addition of Weights and Measures is placed immediately after Addition of Money, it would be as well to defer putting Beginners upon them until they have learn'd Division, as the Questions
then*

The P R E F A C E.

then may be more readily wrought, by adding up the whole of each Denomination, and dividing the Total by such Number as makes one of the next greater; the Remainder or Difference is to be set down, and the Quotient, which is so many of the next Denomination, is to be carried forward.

The Learner having wrought his Question upon a Slate, or Waste Paper, may then copy the Work fair over into his Book under the same; and a little Experience will prove to every one who uses this Book, how much it will contribute to the Scholar's Advancement, not only in creating an Emulation among them, but in cheating them as it were into a thorough Knowledge of the different Rules. Besides, it will have this additional Advantage, each Scholar will be able to preserve his own Performances much better than if transcribed in the old Way into a loose Copy-Book; and in Case he should have Occasion to refresh his Memory in any Thing he may have, for Want of Practice or Inattention, almost forget, from a Review of his own Work, he will not only more readily come into a Knowledge of it again than any other Way, but will also find a secret Pleasure in looking over the same, which, though of many Years standing, may also bring into his Mind many other pleasing Incidents and Transactions.

Since Experience has sufficiently proved that the Plan is practicable as well as useful, if the Alterations and Additions now made to it meet with the further Approbation of the Public, the Author will have his Wish—and any nice Observations, or critical Remarks, from able and experienced Teachers, or such ingenious Gentlemen as make Arithmetic their Study and Amusement, will be deemed a great Honour, and have proper Regard paid to them: Nay, if it should but afford the Candid and Judicious any Hint to improve the proposed Plan, or to render the Science still more easy and intelligible to young Minds, that would give him great additional Pleasure and Satisfaction; and the Acquaintance or Correspondence of such he will always put the highest Value upon.

Newcastle, Sept. 20, 1760.

T H E

T H E C O N T E N T S.

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ERRATA.

Page 6, Line 3, for *Edition*, read *Addition*.

— 6, — 18, — *Joaneses*, — *Joannes*.

— 19, — 21, — *add*, — *added*.

— 53, — 4, — *cost* — *buy*.

— 105, — 22, — $\times$ — $+$.

— —, — 23, — $\div$ — $\div$.

Just Published, Pr. 3s.

LONDON: Printed for C. Hitch and L. Hawes, and J. Richardson, in Pater-Noster-Row; W. Bristow, in St Paul's Church-Yard; and T. Slack, in Newcastle.

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OR,
Entertaining Moralift.

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Select Essays, Relations, Visions and Allegories. Designed for the Use of Schools, as well as the Closet; with a View to form the rising Minds of the Youth of both Sexes to Virtue, and destroy in the Bud, those Vices and Frailties, which Mankind, and Youth in particular, are add'cted to

To which are prefixed, THOUGHTS ON EDUCATION, and the Manner of conveying Instruction properly,

——“ *To rear the tender Thought,
“ To teach the young Idea how to shoot,
“ To pour the fresh Instructions o'er the Mind,
“ To breathe th' enliv'ning Spirit, and to fix
“ The gen'rous Purpose in the glowing Breast.”*

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T H E

School-Master and Scholar's

MUTUAL ASSISTANT.

N U M E R A T I O N

Teaches to read or write any Number set down or proposed.

The T A B L E.

I	Units.	I
21	Tens.	12
321	Hundreds.	123
4321	Thousands.	1234
54321	X Thousands.	12345
654321	C Thousands.	123456
7654321	Millions.	1234567
87654321	X Millions.	12345678
987654321	C Millions.	123456789

A T A B L E of old Roman Numbers.

1	I	10	X
2	II	11	XI
3	III	12	XII
4	IIII or thus IV	18	XVIII or IIXX
5	V	19	XIX
6	VI	20	XX
7	VII	21	XXI
8	VIII or IIX	30	XXX
9	VIIII or IX	40	XL

NUMERATION.

49	XLIX	600	DC or I ^o C
50	L	700	DCC or I ^o CC
59	LIX	710	DCCX
60	LX	1000	CI ^o or M
70	LXX	2000	C ⁱ CCIC or 2 M
80	LXXX	3000	CI ^o CI ^o CI ^o
90	XC	5000	I ^o o
100	C	10000	CC ⁱ CI ^o
200	CC	50000	I ^o o ^o o ^o
210	CCX	50009	I ^o o ^o o ^o IX
300	CCC	100000	CCC ⁱ CI ^o o ^o
310	CCCX	or	CM
350	CCCL	500000	I ^o o ^o o ^o
400	CCCC	1000000	CCCC ⁱ CI ^o o ^o o ^o
409	CCCCIX	1709	MDCCIX
500	D or I ^o	1760	MDCCCLX

QUESTIONS in NUMERATION.

1. Set down in Figures Five Hundred and Nine.

Answer, 509

2. Write down Twelve Thousand and seven.

Answer, 12007

3. Set down Nine Thousand and Eight.

Answer, 9008

4. Set down
- one*
- Thousand Hundred and Three.

Answer, 1103

5. Write down
- one*
- Million Thousand.

Answer, 1002000

6. Set down
- two*
- Million Thousand Hundred.

Answer, 2006400

7. Set down
- three*
- Million Thousand and Four

Answer, 3006004

Questions

A D D I T I O N.

3

QUESTIONS improperly named, tho' often made Use of.

8. Write down Fifteen Hundred.

Answer, 1500

9. Set down Nine Thousand Hundred.

Answer, 9700

10. Write down Eleven Thousand Eleven Hundred and Eleven.

Answer, 11111

11. Set down Nine Million Sixteen Hundred Thousand
Hundred and Seven. *eight*

Answer, 9160807

12. Set down Seven Hundred Million Seventeen Hundred
Thousand Seventeen Hundred and Fifteen Score.

Answer,

N.B. A few more may be added here at Pleasure.

Set Down 506940321
in Words _____



A D D I T I O N.

A D D I T I O N

Teaches to add several Sums together, to produce one Total.

S I M P L E A D D I T I O N.

<i>l.</i>	<i>l.</i>	<i>l.</i>	<i>l.</i>	<i>l.</i>
N ^o 1.	N ^o 2.	N ^o 3.	N ^o 4.	N ^o 5.
8	64	317	1276	3628
5	48	276	287	24836
4	27	196	2486	24876
3	43	258	1276	48362
4	27	127	2483	24876
<u>24</u>	<u>209</u>	<u>1174</u>	<u>231</u>	<u>21251</u>

I N S T R U C T I O N.

Having first carefully placed Units under Units, Tens under Tens, Hundreds under Hundreds, &c. proceed to work as in the first, second, and third Examples, beginning first at Units Place; saying, (as in the first Example) four and three is seven, and four is eleven, and five is sixteen, and eight is twenty-four; which last Sum is the Total, and placed at the Bottom, the four standing in the Place of Units and the two on the Left-hand of it in the Place of Tens. In Example second, add the Units in the same Manner, and they come to twenty-nine; then set down nine in Units Place, and carry the two Tens to the next Row, saying two and two is four, and four is eight, and two is ten, and four is fourteen, and six is twenty, which will be 0 in the Tens Place, and the two set to the Left-hand, is Hundreds, making in all 209. In Example third, proceed in like Manner with each Row; only observe when the third Row is added, the whole Sum is set down, and the fourth Figure stands in the Place of Thousands.—The whole Sum being always to be set down in the last Place.

A D D I T I O N.

5

yards.

43876
24876
40763

24806
46387

180708

ells.

42587
24382
48765

53427
24894

194055

gallons.

876248
487632
240836

536278
763243

2904237

miles.

375423
435690
398346
248762
426382

235876
425476
287620

2032575

leagues.

3876426
2849573
7904679
4178324
3624258

2683425
3824362
2487693

91428720

years.

24870542
31857493
53821678
38762483
27632583

24876243
48762432
34876325

284459779

 To prove Addition, begin at the Top of the Sum, and proceed downwards in the same Manner that it was added upwards; and if the Sum be equal to the first, it is right.

PENCE

P E N C E T A B L E S.

The following TABLES must be got perfectly by Heart, before you proceed to the Compound Edition.

TAB. I.	d.	is	s.	d.
	20	is	1	8
	30	—	2	6
	40	—	3	4
	50	—	4	2
	60	—	5	0
	70	—	5	10
	80	—	6	8
	90	—	7	6
	100	—	8	4
	110	—	9	2
	120	—	10	0

TAB. 2.	s.	is	d.
	2	is	24
	3	—	36
	4	—	48
	5	—	60
	6	—	72
	7	—	84
	8	—	96
	9	—	108
	10	—	120
	11	—	132
	12	—	144

Value of the COMMON COINS used in England.

	l.	s.	d.
A double Joaneſe, equal to	3	12	0
A Joaneſe, or Port Piece	1	16	0
A Moidore	1	7	0
A Guinea	1	1	0
A Half Guinea	0	10	6
A Crown	0	5	0
A Half Crown	0	2	6

And a Shilling, a Six-pence, an Half-penny, and a Farthing.

Note, The following Pieces are only imaginary.

	l.	s.	d.
A Jacobus	1	5	0
A Carolus	1	3	0
A Pound	1	0	0
A Mark	0	13	4
An Angel	0	10	0
A Noble	0	6	8

COM.

A D D I T I O N.

7

COMPOUND ADDITION.

In Addition of several Denominations, it must be observed how many of a smaller Kind make one of the next greater : As, how many Farthings make a Penny, how many Pence a Shilling, and how many Shillings a Pound, &c.

l.	s.
127	14
118	12
572	12
248	8
417	9
148	4
436	17
248	13
376	14
248	16

l.	s.
872	12
146	13
247	8
97	10
248	12
64	14
362	14
127	13
246	17
128	14

l.	s.
427	13
248	12
127	9
247	16
127	13
121	14
87	12
347	15
27	6
164	13

2785 15

2178 13

1105 9

l.	s.	d.
49	14	8
36	17	10
43	8	6
27	18	6
49	16	10
27	14	5
22	12	9
48	13	6
43	12	10
27	16	4
48	13	10
38	17	6

365 9 5

l.	s.	d.
376	12	2
243	6	4
876	16	5
149	17	10
248	9	6
347	15	10
423	11	7
248	13	9
136	14	10
248	13	6
327	14	11
248	13	5

3453 8 6

l.	s.	d.
4762	13	5
2487	8	2
1243	12	6
2487	13	10
3824	17	5
2487	16	10
1462	17	7
1248	15	6
2480	16	10
487	9	5
1248	17	7
2176	10	10

11711

Note,

Note, $\frac{1}{4}$ is one Farthing, or a Quarter of any Thing.
 $\frac{1}{2}$ is one Half-penny, or 2 Quarters.
 $\frac{3}{4}$ is three Farthings, or 3 Quarters.

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
417	10	$4\frac{1}{4}$	127	16	$8\frac{1}{2}$	347	18	$10\frac{1}{2}$
248	7	$6\frac{1}{2}$	49	8	$10\frac{1}{4}$	248	16	$6\frac{1}{4}$
127	14	$8\frac{1}{4}$	217	12	$6\frac{1}{4}$	147	8	$10\frac{1}{2}$
417	16	$10\frac{1}{2}$	176	14	$10\frac{1}{4}$	147	12	$6\frac{1}{4}$
						1085	17	$9\frac{1}{4}$
247	9	$6\frac{3}{4}$	247	16	$5\frac{1}{2}$	127	16	$10\frac{1}{2}$
136	12	$10\frac{1}{2}$	126	14	$9\frac{1}{4}$	247	13	$6\frac{1}{4}$
412	13	$5\frac{1}{4}$	49	17	$3\frac{1}{2}$	127	13	$5\frac{1}{2}$
<u>2008 5 " 4.</u>			<u>996 " 1 " $6\frac{1}{2}$</u>			<u>2030 " 8 " $5\frac{1}{2}$</u>		

<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>	<i>l.</i>	<i>s.</i>	<i>d.</i>
247	16	$10\frac{1}{2}$	417	18	$3\frac{1}{2}$	144	15	$9\frac{1}{4}$
126	14	$8\frac{1}{4}$	247	16	$10\frac{1}{4}$	248	17	$10\frac{1}{2}$
248	17	$10\frac{1}{2}$	246	14	$10\frac{1}{4}$	138	14	$6\frac{1}{4}$
624	9	$5\frac{3}{4}$	127	9	$4\frac{3}{4}$	127	6	$5\frac{1}{2}$
593	11	$6\frac{1}{4}$	468	6	$5\frac{1}{2}$	695	12	$4\frac{1}{4}$
417	12	$6\frac{1}{2}$	47	10	$6\frac{1}{2}$	248	17	$10\frac{1}{2}$
243	13	$10\frac{1}{4}$	217	13	$4\frac{1}{4}$	127	16	$9\frac{1}{4}$
246	17	$4\frac{3}{4}$	149	14	$10\frac{1}{2}$	127	8	$0\frac{1}{2}$
416	10	$6\frac{1}{4}$	48	0	$6\frac{1}{4}$	127	12	$10\frac{1}{2}$
127	13	$6\frac{1}{2}$	248	17	$10\frac{1}{4}$	147	16	$8\frac{1}{2}$
<u>2695 10 412</u>			<u>1078 18 " 11 " $\frac{1}{2}$</u>					

I N S T R U C T I O N.

In adding of Pounds, Shillings, Pence, and Farthings, you must for every 4 Farthings carry 1 Penny to the Pence; for every 12 Pence carry 1 Shilling to the Shillings; and for every 20 in the Shillings carry 1 to the Pounds, which are cast up by Tens as in whole Numbers.—Remember always to begin with the Figures of the lowest Denomination in all Compound Additions.

Note, That in Addition of Money, *l.* stands for Pounds, *s.* for Shillings, *d.* for Pence, *qr* for Farthings; because *Libra* is Latin for a Pound, *Solidus* a Shilling, *Denarius* a Penny, and *Quadrans* a Farthing.

A D D I T I O N.

9

A B I L L of D I S B U R S E M E N T S.

1760.

		l.	s.	d.
Jan. 1.	Laid out in Beef, Eight Groats	0	2	8
	In Mutton, Fifteen-pence Halfpenny	0	1	3 1/2
	In Pork, Three-and-Twenty-pence	0	1	4
2.	In Butter and Eggs, Half a Crown	0	2	6
	In Sugar, Five Groats	0	1	8
3.	In Bread, Two pence Halfpenny	0	0	2 1/2
4.	In Cucumbers, Five Pence	0	0	5

0 10 8.

D E B T S owing to T I M O T H Y T R U S T A L L, viz.

			L.	s.	d.
Abraham Bennett	—	—	57	10	11 1/2
Charles Dunn	—	—	48	12	6 1/2
Edward Parsons	—	—	36	9	8 1/2
William Ward	—	—	31	6	7 1/2
Thomas Johnson	—	—	76	18	10 1/2
Richard Simpson	—	—	53	17	6 1/2
John Andrews	—	—	47	19	10 3/4
George Davison	—	—	28	13	8 1/2
Peter Dodds	—	—	49	16	10 3/4
Samuel Roberts	—	—	38	12	4 3/4
Andrew Smart	—	—	85	17	10 1/2

561 6 11 1/2

B

A D.

A D D I T I O N *of* T R O Y W E I G H T.

By this Weight are weighed Gold, Silver, Jewels, Electuaries,
Liquors, &c.

Note, 24 Grains make 1 Penny Weight } mark'd { dwt.
20 Penny Weights 1 Ounce — } { oz.
12 Ounces — 1 Pound — } { lb.

lb.	oz.	dwt.	gr.	lb.	oz.	dwt.	gr.	lb.	oz.	dwt.	gr.
127	4	14	13	417	6	12	18	248	8	13	20
248	6	13	14	247	10	17	21	618	10	14	19
104	8	16	12	129	4	13	18	247	6	13	19
247	10	17	21	243	6	14	12	127	10	14	13
164	3	11	11	315	4	13	12	420	11	13	11
413	8	14	18	123	9	13	16	217	9	12	14
247	10	13	12	149	10	14	13	127	10	16	19
327	8	14	13	216	8	16	18	218	7	12	22

1867 216 18

I N S T R U C T I O N.

Having placed your Numbers in their proper Places, that is, each under its own Denomination; then for every 24 Grains carry one to the next Denomination, i. e. Penny Weights, for 20 Penny Weights carry one Ounce, and for 12 Ounces carry One Pound; and so with all the other Weights and Measures, carrying always according to the Value of the next higher Denomination.

A V O I R.

A D D I T I O N.

11

A V O I R D U P O I S W E I G H T.

By this Weight are weighed all Grocery Wares, and Copper, Tin, and all Metals, except Gold and Silver; also Flesh, Butter, Cheese, Salt; likewise Pitch, Tar, Rosin, &c.

Note, 16 Drums make 1 Ounce —
 16 Ounces — 1 Pound — —
 28 Pounds — 1 Qr. of an Hun. Wt. } mark'd { oz.
 4 Quarters — 1 Hundred Weight } lb.
 20 Hund. Wt. 1 Ton — — } qrs.
 C.
 ton.

tons.	cwt.	qrs.	lb.	cwt.	qrs.	lb.	oz.	qrs.	lb.	oz.	drs.
77	13	1	13	87	3	21	12	149	13	10	8
29	13	3	18	26	2	18	13	239	15	12	6
13	17	3	12	43	2	13	14	126	15	13	12
37	10	2	24	56	3	15	8	365	20	14	13
43	8	1	13	25	2	16	10	248	13	12	10
62	12	2	18	37	3	18	9	126	14	13	9
43	16	3	14	44	2	13	14	248	13	10	12
64	17	2	19	36	3	22	6	126	12	6	13
28	14	3	22	27	3	18	13	249	17	12	12
36	13	2	18	49	3	23	12	126	14	13	13

A P O T H E C A R I E S W E I G H T.

Note, 20 Grains make	—	1 Scruple
3 Scruples	— — —	1 Dram.
8 Drams	— — —	1 Ounce.
12 Ounces	— — —	1 Pound.

Note, They compound their Medicines by this Rule, yet buy and sell their Commodities by Avoirdupois Weight.

<i>lb. oz. dr. sc. gr.</i>	<i>lb. oz. dr. sc. gr.</i>	<i>lb. oz. dr. sc. gr.</i>
18 6 3 2 12	42 8 3 1 14	144 5 5 1 12
24 8 3 1 16	27 10 5 2 16	248 9 5 2 12
47 10 5 2 13	34 8 6 1 13	127 6 4 1 15
32 4 6 1 15	98 9 4 2 18	96 8 4 2 12
38 4 5 2 19	8 10 3 0 18	117 6 4 2 13
32 6 1 1 9	8 6 3 1 14	626 7 2 1 15
78 6 4 2 12	37 10 5 1 13	149 10 6 1 13
38 9 6 1 14	49 8 6 2 14	248 9 5 2 16
27 10 4 2 13	29 9 4 1 13	127 10 4 1 12

LIQUID

LIQUID MEASURE.

The DENOMINATIONS of WINE MEASURE.

Note, 2 Pints make 1 Quart.
 4 Quarts — 1 Gallon.
 10 Gallons — — 1 Anchor of Brandy or Rum.
 18 Gallons — 1 Rundlet.
 31½ Gallons — 1 Barrel.
 42 Gallons — 1 Tierce.
 63 Gallons — 1 Hoghead.
 2 Hogheads — 1 Pipe or Butt.
 2 Pipes — 1 Tun.

<i>tuns. h. gal. qts.</i>	<i>hds. gal. qts. pint.</i>	<i>tier. gal. qts. pint.</i>
18 3 27 3	48 34 2 1	64 36 3 1
24 2 48 2	45 27 3 0	48 25 2 0
43 3 36 3	27 24 2 1	36 27 3 1
36 2 25 2	36 48 3 0	48 18 2 0
47 3 37 2	27 36 2 1	37 28 3 1
28 2 42 3	49 28 3 1	26 30 2 1
86 2 27 2	29 19 2 1	34 18 2 1
23 3 36 3	42 26 2 0	26 26 2 0
_____	_____	_____
_____	_____	_____

WINCHESTER MEASURE.

The DENOMINATIONS of ALE and BEER MEASURE.

Note, 2 Pints	make	1 Quart.
4 Quarts	— —	1 Gallon.
8½ Gallons	—	1 Firkin.
17 Gallons	— —	1 Kilderkin.
34 Gallons	—	1 Barrel.
51 Gallons	— —	1 Hoghead.

hds. gal. qts.

148 27 3
 246 18 2
 284 36 3
 364 28 2

hds. gal. qts.

846 34 2
 124 18 3
 208 26 3
 138 42 2

hds. gal. qts.

327 32 3
 246 19 2
 128 19 3
 287 36 3

426 36 3
 248 28 2
 127 36 3
 208 26 0
 127 42 3

246 26 3
 128 32 1
 196 27 3
 127 19 2
 282 29 3

126 27 3
 248 36 2
 149 32 2
 246 27 3
 124 36 2

Note, In London their Ale and Beer Measure differs ; they compute eight Gallons to the Firkin of Ale, and nine Gallons to that of Beer.

L O N G M E A S U R E.

3 Barley Corns	make	1 Inch.
12 Inches	—	1 Foot.
3 Feet	—	1 Yard.
6 Feet	—	1 Fathom.
5 Yards and a Half		1 Rod, Pole, or Perch.
40 Poles	—	1 Furlong.
8 Furlongs	—	1 Mile.
3 Miles	—	1 League.
60 Miles	—	1 Degree.

Note, A Degree is 69 Miles and 4 Furlongs very near, tho' commonly reckoned but 60 Miles.

<i>mil. fur. po.</i>	<i>lea. mil. f. po.</i>	<i>yds. f. in. bc.</i>
248 6 18	124 2 4 19	246 2 6 2
189 4 23	248 1 6 27	124 2 10 1
417 5 26	174 2 5 36	248 1 9 2
274 3 28	198 1 4 23	127 0 11 1
138 3 18	127 2 6 14	256 1 8 2
426 6 23	248 1 4 26	127 2 9 1
417 4 27	276 1 3 17	127 1 8 1
248 4 13	142 2 4 18	246 1 5 2
127 4 26	243 1 5 23	127 2 7 1
248 3 18	127 2 4 18	243 1 6 2
— — —	— — —	— — —
— — —	— — —	— — —

A D D I T I O N.

L A N D M E A S U R E.

9 Square Feet make	—	—	1 Yard.
30 Yards and a Quarter	—	—	1 Pole.
40 Poles long and 1 broad	—	—	1 Rood.
4 Roods	—	—	1 Acre.

<i>acr. ro. po.</i>	<i>acr. ro. po.</i>	<i>acr. ro. po.</i>
164 3 17	246 2 24	364 3 28
246 2 12	127 2 18	247 2 18
124 3 25	216 2 23	527 3 36
248 2 30	427 3 32	248 2 28
327 2 18	246 2 26	187 3 18
436 3 28	124 3 30	248 2 28
248 2 31	149 2 26	187 1 17
129 1 17	146 1 19	174 2 26

C L O T H M E A S U R E.

2 Inches and a Quarter make	1 Nail.
4 Nails	1 Quarter of a Yard.
4 Quarters	1 Yard.
5 Quarters	1 English Ell.
3 Quarters	1 Flemish Ell.

<i>yds. qr. na.</i>	<i>Ells. en. q. na.</i>	<i>Ells. f. q. na.</i>
127 2 3	246 3 3	127 1 2
276 2 2	124 2 2	198 2 3
126 3 3	246 3 3	260 1 2
284 2 1	224 2 3	126 0 3
126 3 2	198 2 3	245 1 2
287 2 3	127 2 2	127 2 3
126 3 2	248 3 3	246 2 2

D R Y

A D D I T I O N.

17

DRY MEASURE.

2 Pints	—	make	—	1 Quart.
2 Quarts	—	—	—	1 Pottle.
2 Pottles	—	—	—	1 Gallon.
2 Gallons	—	—	—	1 Peck.
4 Pecks	—	—	—	1 Bushel.
8 Bushels	—	—	—	1 Quarter.
5 Quarters	—	—	—	1 Wey.
2 Weys	—	—	—	1 Last.

<i>la.</i>	<i>w.</i>	<i>q.</i>	<i>bu.</i>	<i>bu.</i>	<i>pec.</i>	<i>ga.</i>	<i>po.</i>	<i>gal.</i>	<i>qu.</i>	<i>pt.</i>
417	1	2	6	127	3	1	1	347	3	1
248	0	3	4	248	2	0	1	246	2	0
127	1	3	6	124	3	1	0	127	3	1
287	1	4	3	145	2	0	1	362	2	0
324	0	2	4	125	2	1	0	124	3	1
260	1	3	5	217	2	0	1	264	2	0
123	0	2	4	326	2	1	0	126	3	1
265	1	3	4	287	1	0	1	246	2	0
327	1	3	5	126	2	1	1	126	3	1
138	0	4	3	164	3	0	1	254	2	1

C

TIME.

T I M E

60 Seconds	—	make	—	1 Minute.
60 Minutes	—	—	—	1 Hour.
24 Hours	—	—	—	1 Day.
7 Days	—	—	—	1 Week.
4 Weeks	—	—	—	1 Month.

13 Months 1 Day, and 6 Hours 1 common or Julian Year.

A Solar Year is computed to be 365 Days, 5 Hours, 48 Minutes, and 55 Seconds.

<i>mon. w. d.</i>	<i>ho. min. se.</i>	<i>ho. min. se.</i>
317 3 4	48 18 27	419 27 36
246 2 4	27 24 38	247 38 39
348 3 3	54 32 43	128 48 49
236 2 2	49 25 33	246 32 37
127 3 5	56 48 43	128 26 54
247 2 4	38 26 26	198 37 28
554 3 4	89 32 38	189 26 34
245 2 6	74 28 26	249 38 36
348 3 3	49 36 38	128 45 43

Note, As an Hour is divided into 60 Minutes, and a Minute into 60 Seconds; so the Mathematicians, in nice Calculations, subdivide 1 Second into 60 Thirds, and 1 Third into 60 Fourths, &c. as far as they please, marking them thus:

days. ° ' " ''' ""

12 : 17 : 19 : 36 : 48 : 29, &c.



S U B T R A C T I O N.

S U B T R A C T I O N

Teacheth to take a lesser Number from a greater, to find the Remainder or Difference. To prove the Work, add the Difference to the less Number; and if the Sum be the same as the greater, the Work is right, otherwise false.

E X A M P L E S.

	N ^o 1.	N ^o 2.	N ^o 3.
	<i>l.</i>	<i>l.</i>	<i>l.</i>
From	8643	6325	893764
Take	2312	3487	248785
Rem.	6331	2838	<i>644909</i>

I N S T R U C T I O N.

To perform Subtraction, begin with the lesser Sum at the first Figure on the Right-hand, as in the first Example; saying, 2 from 3, there remains 1, which set down; 1 from 4, there remains 3; 3 from 6, there remains 3; and 2 from 8, there will be 6, always setting down the Remainders, Figure under Figure as you go on; but when any of the lower Figures are larger than the above, work as in the second Example; saying, 7 from 5 I cannot, therefore I borrow 10, which add to 5, make 15; then take 7 from 15, and there remains 8, which is set down, carrying the 1 borrowed to the next Figure 8, which makes 9; then say 9 from 2 I cannot, but 9 from 12, and there remains 3, carrying the 1 borrowed to the next 4, which makes 5; then 5 from 3 I cannot, but 5 from 13, and there remains 8, that's 8 and carry 1; which 1, carried to the 3, is 4; then 4 from 6, and there remains 2.

yards.

SUBTRACTION.

	<i>yards.</i>	<i>yards.</i>
From	37624836	2483624836
Take	24876354	1204307865
Rem.	<u>12748482</u>	<u>1219253971</u>

	<i>miles.</i>	<i>miles.</i>
From	42658276	8267382458
Take	24876342	4876358329
Rem.	<u>17181734</u>	<u>3391024129</u>

	<i>hours.</i>	<i>hours.</i>
From	627830456	624876004
Take	248765483	248792438
Rem.	<u>379064973</u>	<u>381024129</u>

SUBTRACTION of DIVERS DENOMINATIONS.

	N ^o 1.		N ^o 2.		N ^o 3.	
	<i>l.</i>	<i>s.</i>	<i>l.</i>	<i>s.</i>	<i>l.</i>	<i>s.</i>
From	4876	8	3276	12	4263	13
Take	2487	16	2487	16	2487	15
Rem.	2388	12	<u>1775</u>	<u>18</u>	<u>1775</u>	<u>16</u>

I N S T R U C T I O N.

In Subtraction of divers Denominations, always remember to borrow (if Need be) according to the Value of the next higher Denomination, as in the first Example above, 16s. cannot be taken from 8s. therefore, 1l. or 20s. is borrowed, which, added to 8s. make 28s. then 16s. from 28s. and there remains 12s. which I set down and carry 1 for that which I borrowed to the Pounds, viz. which added to 7, makes 8, and so work as in the foregoing Questions.—When the upper Number happens to be a Cypher, always borrow according to the Value of the next higher Denomination; take the under Number from it, and, setting down the Remainder, carry one to the next Figure or Figures.

Bor.

SUBTRACTION.

21

	<i>l.</i>	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>	<i>d.</i>
Borrowed	24638	6	10		3276345	10	4
Paid	18764	12	4		2473625	17	6
Unpaid	<u>5873 14" 6</u>				<u>792719 12 10</u>		

	<i>l.</i>	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>	<i>d.</i>
Borrowed	4263	12	4 $\frac{3}{4}$		3624	13	8 $\frac{1}{4}$
Paid	2487	18	6 $\frac{1}{4}$		2487	19	6 $\frac{1}{2}$
Unpaid	<u>1775 13102/1</u>				<u>1136 14224/1</u>		

	<i>l.</i>	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>	<i>d.</i>
Lent	4368	8	4 $\frac{1}{4}$		2436	00	2 $\frac{1}{2}$
Received	2487	12	6 $\frac{1}{2}$		1243	12	6 $\frac{3}{4}$
Due	<u>1880 1593/4</u>				<u>1192 773/4</u>		

	<i>l.</i>	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>	<i>d.</i>
Dr.	3274	18	3		4207	12	6 $\frac{1}{4}$
Cr.	2043	9	7 $\frac{1}{2}$		2483	17	9 $\frac{1}{4}$
Balance	<u>1231 871/2</u>				<u>1883 1481/2</u>		

	<i>l.</i>	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>	<i>d.</i>
Dr.	4279	7	0 $\frac{3}{4}$		3276	12	9 $\frac{1}{4}$
Cr.	1287	13	5 $\frac{3}{4}$		2487	13	11 $\frac{3}{4}$
Balance	<u>2991 1361/2</u>				<u>78819 10/2</u>		

SUBTRACTION.

A certain Man, deceased, left in Money and Goods 5196 l. 19 s. 11½ d. whereof he bequeathed to one Friend 390 l. 16 s. 9 d. to another 50 l. 17 s. to another 46 l. 16 s. Funeral Expences 80 l. 15 7¼ d. to the Poor 100 l. What remains for the Executor?

		l.	s.	d.
Sum left	—	5196	19	11½
First Friend	—	390	16	9
Second Friend	—	50	17	0
Third Friend	—	46	16	0
Funeral Expences	—	80	15	7½
The Poor	—	100	0	0
Legacies paid	—	669	3	4¼
Due to the Executor	—	4527	16	7½

Take 18 s. 10 d. from 15 6 and what remains?

From 10 10
15 6
3 4 take 8½ d. and what remains?

TROY WEIGHT.

	lb.	oz.	dwt.	grs.	lb.	oz.	dwt.	grs.
Bought	674	8	12	13	246	6	10	12
Sold	248	10	14	16	146	8	16	15
Unfold	<u>425 9 17 21</u>				<u>999 13 21</u>			

A VOIR-

SUBTRACTION.

23

AVOIRDUPOIS WEIGHT.

	ton. ct. qr. lb. oz. dr.	ton. ct. qs. lb. oz. dr.
Bought	432 12 1 13 8 6	376 10 2 16 14 10
Sold	283 18 2 19 10 12	247 13 2 21 6 15
Unfold	<u>148 52 13 10</u>	<u>128 16 3 27 11</u>

APOTHECARIES WEIGHT.

	lb. oz. dr. sc. gr.	lb. oz. dr. sc. gr.
From	642 4 3 1 14	376 6 4 0 12
Take	287 6 4 2 17	248 8 6 1 14
Rem.	<u>354 9 6 1 17</u>	<u>127 9 5 1 18</u>

WINE MEASURE.

	tuns. h. gal. qts. pts.	tuns. h. gal. qts. pts.
From	127 1 17 1 0	376 2 25 2 1
Take	68 2 23 2 1	249 2 48 3 1
Rem.	<u>68 2 56 2 1</u>	<u>130 3 39 3 0</u>

WINCHESTER MEASURE.

	hds. gal. qts.	hds. gal. qts.	hds. gal. qts.
Bought	427 27 1	470 17 2	234 12 0
Sold	246 38 2	189 25 3	189 19 1
Unfold	<u>1203 9 3</u>		<u>644 33</u>

LONG MEASURE.

	mil. fur. po.	yds. f. in.	f. in. bc.
From	476 3 12	276 1 6	174 4 1
Taken	248 4 16	189 2 9	26 7 2
Rem.	<u>221 6 36</u>	<u>96 1 9</u>	

LAND

SUBTRACTION.

LAND MEASURE.

	<i>acr. ro. per.</i>	<i>acr. ro. per.</i>	<i>acr. ro. per.</i>
From	246 1 12	174 2 16	300 1 23
Taken	189 2 19	96 3 18	187 3 33
Rem.	<u>56 232</u>	<u>77 232</u>	<u>112 1 30</u>

CLOTH MEASURE.

	<i>yds. qr. na.</i>	<i>Ells. en. q. na.</i>	<i>Ells. f. q. na.</i>
Bought	124 1 2	257 2 1	576 0 1
Sold	84 2 3	186 3 2	124 1 2
Unfold	<u>392 3</u>	<u> </u>	<u> </u>

DRY MEASURE.

	<i>lasts. w. qr. bu. pec. ga.</i>	<i>lasts. w. qr. bu. pec. ga.</i>
From	176 0 2 3 1 0	300 1 3 4 2 0
Take	97 1 3 4 2 1	276 1 3 6 3 1
Rem.	<u> </u>	<u> </u>

TIME.

	<i>w. d. h. m. se.</i>	<i>w. d. h. m. se.</i>
From	14 4 10 27 18	87 3 18 12 31
Take	9 6 15 42 37	24 4 6 37 39
Rem.	<u> </u>	<u> </u>

A Gentleman let a Lease in the Year
How many are expired this present Year
to come? Answer,

for 99 Years:
and how many

A Castle that was begun in the Year
Years in building: I demand the Year in which it was finished,
and how many Years since? Answer,

M U L.



M U L T I P L I C A T I O N .

The following TABLE must be learnt perfectly by Heart, before you can proceed any further.

The TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

MULTIPLICATION is a short Way of performing several Additions, and consists of three Parts, viz.

- 1st, The Multiplicand, or Sum to be multiplied.
- 2d, The Multiplier, or Sum by which you multiply.
- 3d, The Product, or total Sum thence arising.

E X A M P L E S.

	<i>l.</i> N ^o 1.		<i>l.</i> N ^o 2.
Multiplicand	9 2 6	Multiply	2 8 4 6 3 2 7
Multiplier	2	By	3
Product	<u>1 8 5 2</u>	Product	<u>8 5 3 8 9 8 1</u>

Mult.	4 2 6 3 8 7 6 5 4	8 7 6 2 4 3 2 4 8 7 6
By		
Prod.	<u>1 7 0 5 5 0 6 0</u>	<u>2 5 4 5 0 4 9 2 2</u>

I N S T R U C T I O N.

When the Multiplier is a single Figure, multiply every Figure in the Multiplicand by it, carrying 1 for every 10, as in Addition of whole Numbers, and you have the Product or Answer, as may be seen in the first Example, which is multiplied by 2; saying, twice 6 is 12, that's 2 above 10; therefore, 2 is set down in the Product, and 1 carried, then twice 2 is 4, and that 1 carried to it makes 5, which set down, and it being under 10, nothing is carried; then again, two Times 9 is 18, which, being the last, is set down, and the Product or Answer found to be 1852, as above. When Cyphers are placed at the End of the Multiplier, (as in the following Examples) omit them till you have multiplied by the significant Figures; and then annex the like Number to the Product.

Mult.

MULTIPLICATION.

27

$$\begin{array}{r}
 \text{Mult.} \quad 6382484654 \quad 24870458362 \\
 \text{By} \quad \quad \quad 500 \quad \quad \quad 0000 \\
 \hline
 \text{Prod.} \quad \underline{3192423210} \quad \underline{0049222150172} \quad 000
 \end{array}$$

$$\begin{array}{r}
 \text{Mult.} \quad 4287536248 \quad 7624382458 \\
 \text{By} \quad \quad \quad 0000 \quad \quad \quad 00000 \\
 \hline
 \text{Prod.} \quad \underline{34300289984000} \quad \underline{6861941122} \quad 00000
 \end{array}$$

$$\begin{array}{r}
 \text{Mult.} \quad 4287626 \quad 6487625 \quad 8763248 \\
 \text{By} \quad \quad \quad 200 \quad \quad \quad 370 \quad \quad \quad 58 \\
 \hline
 \begin{array}{r}
 95725756 \quad 045413375 \quad 070105984 \\
 8575252 \quad 19462875 \quad 13246240 \\
 111478276 \quad 02142125052268384
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 \text{Mult.} \quad 3280658 \quad 632783 \quad 84263248 \\
 \text{By} \quad \quad \quad 64 \quad \quad \quad 56 \quad \quad \quad 79 \\
 \hline
 \begin{array}{r}
 1913122632 \quad 3796698 \\
 683948 \quad 63915 \\
 209962112
 \end{array}
 \end{array}$$

INSTRUCTION.

When there are several Figures in the Multiplier, there must be as many several Products, as there are Figures in the Multiplier, which several Products added together, will produce the Total.

Mult.

	<i>l.</i>	<i>l.</i>	<i>l.</i>
Mult. 2 4 8 7 6 2 4 3	8 2 4 6 3 2 4	5 4 2 7 6 2 8	
By <u>3</u>	<u>4</u>		
4620729	32985296		

Mult. 3 2 7 6 0 5 8 2 6

By _____

8 2 6 3 2 4 8 7 6 3

I N S T R U C T I O N.

When Cyphers are intermix'd with significant Figures in the Multiplier, multiply by the significant Figures only, setting the first Figure arising in each Product under that of the same Denomination with the multiplying Figure.

Mult.

MULTIPLICATION. 29

	1.	1.
Mult.	624382087	2483762438
By		

Mult.	824638247362468
By	

To prove MULTIPLICATION.

It is common to prove it by the Cross, but then it is subject to Errors ; therefore, the best Way is to change the Multiplicand into the Multiplier, and proceed as before ; then if the Product be the same as the other, your Work is right.

P R A C T I C E

30 MULTIPLICATION.

PRACTICAL QUESTIONS *in* MULTIPLICATION.

What comes Seven Pounds to, at 8 d. $\frac{1}{2}$ per Pound?

What comes 14 Pounds to, at 2^s 6^d 2 per Pound?

$$\begin{array}{r} 2 \\ 2 \\ \hline 5 \end{array}$$

What comes 1 Stone to, at 1^s 15^d 0^q per Stone?

$$\begin{array}{r} 15 \\ 15 \\ \hline 1 \end{array}$$

What comes 5 Yards to, at 1^s 4^d 6 per Yard?

$$\begin{array}{r} 4 \\ 4 \\ \hline 6 \end{array}$$

What comes Ells to, at per Ell?

What

M U L T I P L I C A T I O N .

31

What come *45* Gallons to, at *L. 19. 11* per Gallon?

5

What's the Price of Hogheads, at per Hhd?

What's the Price of Cwt. at per Cwt.

What's the Price of Cwt. at per Cwt.

What's

32 M U L T I P L I C A T I O N .

What's the Price of Tons, at per Ton ?

What comes Tons to, at per Ton ?

What comes Tons to, at Ton ?



D I V I S I O N.

D I V I S I O N

Is the separating or parting of any Number or Quantity given into any Parts assigned, or to find how often one Number is contained in another; and in it four Things are to be remarked, viz.

- 1st, The Dividend, or Sum to be divided.
- 2d, The Divisor, or that Number by which we divide.
- 3d, The Quotient, or Answer to the Question.
- 4th, The Remainder, which is always less than the Divisor, and of the same Name with the Dividend.

There are two Sorts of Division, viz. Short Division and Long Division: By short Division is meant when the Divisor does not exceed 12; and Long Division, when the Divisor is more than 12. In Long Division, we are obliged to assist the Memory by multiplying the Quotient Figure and Divisor together, and to subtract that Product from the Dividend, in order to find out the Remainder; which Operation must be continued to every Quotient Figure.

D I V I S I O N.

S H O R T D I V I S I O N.

$$\begin{array}{r} \text{N}^{\circ} 1. \\ 2 \overline{) 46836} \\ \underline{23418} \end{array}$$

$$\begin{array}{r} \text{N}^{\circ} 2. \\ 3 \overline{) 2762483} \\ \underline{920827-2} \end{array}$$

$$\begin{array}{r} A) 2487632483 \cdot \\ \underline{.621900120-3} \end{array}$$

$$\begin{array}{r}) 384283672 \\ \hline \end{array}$$

$$\begin{array}{r}) 8243827625 \\ \hline \end{array}$$

$$\begin{array}{r}) 3248706243 \\ \hline \end{array}$$

$$\begin{array}{r}) 2438762432 \\ \hline \end{array}$$

$$\begin{array}{r}) 24876243824 \\ \hline \end{array}$$

I N S T R U C T I O N.

In the first Example in Short Division, take the Divisor 2, and ask how often it is contained in 4, (the first Figure in the Dividend) which will be twice, and nothing remains; then ask again, how often 2 in 6, it will be 3 Times, and nothing remains; then again, how often 2 in 8, it is 4 Times, and nothing remains; then how often 2 in 3, it is 1, and 1 remains, which 1 call ten, and add to the next 6, will make 16; then how often 2 in 16, it will go 8 Times.—Observe that the Number of Times which the Divisor is contained in the Dividend are all set down Figure under Figure as you go along, and make the Quotient, in this Case, 23418. If it happens there be a Remainder, it is placed after the Sum, as in the second Example.

L O N G

D I V I S I O N.

35

LONG DIVISION.

N^o 1.
divisor. *dividend.* *quotient.*
 45) 32876 (730
 315

 137
 135

Remainder 26

486324 (
121501

N^o 2.
divisor. *dividend.* *quotient.*
 79) 24876324 (

5) 27632836 (
 5526367-1

I N S T R U C T I O N.

In Long Division, when there is 2, 3, or more Figures in the Divisor work as in the first Example: Ask how often the Divisor 45 is contained in 328, (the three first Figures in the Dividend) and it will be 7 Times; which 7 place in the Quotient, and multiplying the Divisor by it, the Product is 315; then subtract 315 from 328, and there remains 13, to which take down the next Figure in the Dividend, and it makes it 137; then how often the same Divisor 45 in 137, it will be 3 Times, which carry to the Quotient, and multiplying the Divisor by it, the Product is 135; then subtract 135 from 137, and there remains 2, to which Remainder bring down the next Figure in the Dividend, and it makes 26; then how often 45 in 26, it will be no Times, which, 0 carried to the Quotient, makes it 730 for the Answer, and the 26 must stand for the Remainder.

Note, Always after you subtract, observe that the Remainder is less than the Divisor.

$$\begin{array}{r}
 4 \overline{) 876243824} \qquad \qquad \qquad \overline{) 876243824} \\
 \underline{219060956} \\
 4 \\
 \underline{076240024}
 \end{array}$$

A COMPENDIOUS WAY of DIVISION.

E X A M P L E S

Ex. 1.

$$1,000 \overline{) 8764,000}$$

Ex. 2.

$$6,00 \overline{) 4284,00}$$

Ex. 3.

$$12,00 \overline{) 48764,38}$$

8764 Anf. 714 Anf. 4063—838

Quotient *Quotient* *Quotient*

$$\begin{array}{r}
 4439 \overline{) 4287643} \qquad \qquad \qquad 29 \overline{) 876248}
 \end{array}$$

I N S T R U C T I O N.

Whenever there are Cyphers at the End of the Divisor, cut them off, and so many as are cut off the Divisor, the same Number of Figures must likewise be cut off the Dividend; then work the Sum without any Regard being had to the Figures cut off; only remember when the Work is done to annex to the Remainder those Figures cut off the Dividend, as in Example 3.

EX-

D I V I S I O N.

37

E X A M P L E S *in* D I V I S I O N.

N^o 1.

Divide 48762 by 24

$$\begin{array}{r} 6 \overline{) 48762} \\ 4 \overline{) 8127} \end{array}$$

Anf. 2431—3 rem.

N^o 2.

Divide 876324 by 4

$$\begin{array}{r} 219006 \\ 4 \overline{) 876324} \\ \underline{219006} \\ 324 \end{array}$$

Divide 8762408 by 5

$$\begin{array}{r} 1752481 \\ 5 \overline{) 8762400} \\ \underline{1752400} \\ 3 \end{array}$$

Divide 3627843 by

I N S T R U C T I O N.

When the Divisor is such, that any two or more Numbers multiplied together will make the said Divisor, it is shorter to divide by those Numbers separately, as may be seen in the first Example: Instead of dividing at once by 24, it is first divided by 6, and the Quotient by 4, which make 24, and the Answer is the same as if divided by 24.

E X.

E X A M P L E S *in* D I V I S I O N.

Divide 135 l. 4 s. among 16 Men, and give them each an equal Share.

$$\begin{array}{r} \text{l. s.} \\ 16 \overline{) 135,4} \text{ (8} \\ \underline{128} \end{array}$$

$$\begin{array}{r} 7 \\ \underline{20} \end{array}$$

Anf. 8 l. 9 s.

$$\begin{array}{r} 16 \overline{) 144} \text{ (9} \\ \underline{144} \end{array}$$

Divide

among

Men,

I N S T R U C T I O N.

When different Denominations, (whether Money, Weight, or Measure) are given to be divided amongst a certain Number of Persons, the greatest Denomination is first divided by the Number of Persons, and what remains is multiplied by so many of the next lesser Denomination, as make one of the greater, (remembering if there are any of the lesser Denomination, to add them to the Product) and then divide by the same Divisor, still continuing to work so till brought into the lowest Denomination or Name.

Note, In the above Example, if there had been a Remainder after the Shillings, it must have been multiplied by 12, and divided again by 16 the same Divisor for the Pence, and multiplied by 4, &c. for Farthings.

Divide

D I V I S I O N.

39

Divide

among

Men.

Divide

among

Men.

Divide

among

Men.

Divide

among

Men.

QUE-

QUESTIONS *to exercise* DIVISION.

A Captain and 250 Men took a Prize worth 450 l. of which the Captain is to have $\frac{1}{3}$ for his Share, and the rest to be equally divided among the Men; how much will each Man get?

I demand what is the $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, and $\frac{1}{12}$ of

One Half is -----

One Third is ---

One Fourth is -----

One Fifth is -----

One Sixth is -----

One Seventh is -----

One Eighth is -----

One Ninth is -----

One Twelfth is -----

If 56 Bushels of Oats be allowed to 32 Horses for a Month;
How many Pecks shall each Horse have for his Share?

If a Hoghead of Wine is given to be drunk amongst 96 Persons, and supposing each Person to drink the same Quantity; How much will come to each Person's Share?

Note, Division and Multiplication do interchangeably prove one another; for in Division, if you multiply the Quotient by the Divisor, the Product will be equal to the Dividend.



R E D U C T I O N.

This Rule shews how to bring all Sums of great Denominations into small ones of another Denomination, still retaining the same Value, by Multiplication, and all Sums of lesser Denominations into greater by Division.

EXAMPLES *in* REDUCTION of MONEY.

EXAMPLE I.

In 24l. How many Shillings and Pence ?

$$\begin{array}{r}
 20 \\
 \hline
 480 \text{ Shillings} \\
 12 \\
 \hline
 \end{array}$$

Ans. 5760 Pence.

I N S T R U C T I O N.

When it is required to reduce a Sum or Number of a greater Denomination into a less, (but still retaining the same Value) multiply the given Sum by as many of the next less Denomination as will make one of the greater ; as in the first Example, 24l. multiplied by 20, the Shillings in a Pound, produces 480 Shillings ; and then 480 Shillings, multiplied by 12, the Pence in a Shilling, produces 5760 Pence, which are equal to the 24l. or the Pence might be found by multiplying the Pounds by 240, the Number of Pence in a Pound. On the contrary, when a small Kind, or Denomination is given to be brought into a greater one, it is divided by as many of the same Kind as will make one of the next greater ; as in the second Example, 5760 Pence is divided first by 12, (the Pence in a Shilling) and quotes Shillings, and those Shillings again by 20, (the Shillings in a Pound) quotes 24l. which proves the preceding Question.

In

REDUCTION.

43

EXAMPLE 2.

In 5760 Pence, how many Pounds Sterling?

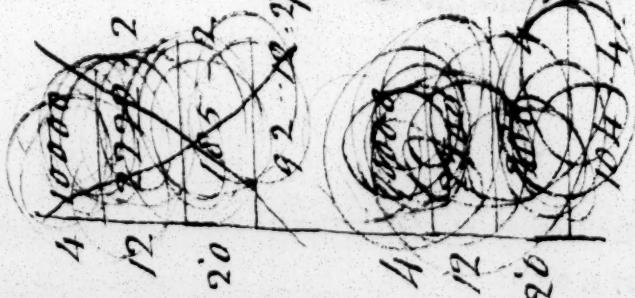
$$\begin{array}{r} 12 \overline{) 5760} \\ 2 \overline{) 080} \end{array}$$

Ans. 24 Pounds.

In 4198 Pounds, how many Farthings?

~~$$\begin{array}{r} 12 \overline{) 4198} \\ 12 \\ \hline 90936 \\ 80 \end{array}$$~~

In 10000 Farthings, how many Pounds?



How many Two-pences in

Pounds?

In

In Two-pences, how many Pounds ?

How many Half-Crowns in Guineas ?

In Half-Crowns, how many Guineas ?

How many French Crowns, at each, are equal in
Value to British Crowns ?

How many Dollars, at 4 s. 6 d. are equal to
Moidores, at 27 s. each ?

How many Marks, at 13 s. 4 d. each, are equal to
Pieces of Money, at per Piece ?

R E D U C T I O N. 45

REDUCTION *of* TROY WEIGHT.

Reduce lb. oz. dw. gr. into Grains ?

In Grains, how many Pounds ?

In Ingots of Silver, each 27 oz. 10 dwts. how
many Grains ?

AVOIR-

AVOIRDUPOIS WEIGHT.

In Tons C. qrs. lb. oz. how
many Drams ?

In

Drams, how many Tons ?

In Pigs of Lead, each weighing
how many Fother, at $19 \frac{1}{4}$ C. ?

R E D U C T I O N. 47

A P O T H E C A R I E S W E I G H T.

In lb. oz. drs. sc. how many
Grains?

In Grains, how many lb. ?

In oz. dr. how many Grains ?

LIQUID MEASURE.

In

Tuns of Wine, how many Gallons?

In

Gallons, how many

Rundlets of Wine, each containing 18

How many

in

Hogsheads of Ale?

R E D U C T I O N.

49

L O N G M E A S U R E.

How many
and London, it being 274 Miles ?

is it betwixt Newcastle

In

how many Miles ?

G

LAND

50 R E D U C T I O N .

L A N D M E A S U R E .

In 1428 Acres, how many Roods and Perches ?

$$\begin{array}{r} 4 \overline{) 1428} \\ \underline{12} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

20 Roods

An Estate of 145 Acres is left equally amongst four Sons ;
I desire to know how many Perches there are in each one's Share ?

$$\begin{array}{r} 145 \\ 4 \overline{) 580} \\ \underline{40} \\ 180 \\ 4 \overline{) 23200} \\ \underline{5800} \end{array}$$

Reduce 5800

Perches into Acres

$$\begin{array}{r} 40 \overline{) 5400} \\ \underline{40} \\ 1400 \\ 4 \overline{) 125} \\ \underline{120} \\ 50 \\ 4 \overline{) 5000} \\ \underline{40} \\ 145 \\ 4 \overline{) 36-1} \\ \underline{36} \\ 1 \end{array}$$

31 - 1

36

4

145

CLOTH

R E D U C T I O N. 51

C L O T H M E A S U R E.

In Pieces of Cloth, each Piece Yards, how
many Quarters and Nails ?

In Nails of Irish Cloth, how many Pieces,
each Piece consisting of Yards ?

In Ells of Holland, how many Ells English ?

D R Y

DRY MEASURE.

In Quarters of Wheat, how many Pecks ?

In Pecks, how many Quarters ?

How many Bushels in Lasts ?

TIME.

R E D U C T I O N.

53

T I M E.

How many Days old must a Person be, that was born on Christ-
mas-Day 17 this being 17

In

Days, how many

T A R E.

T A R E *and* T R E T.

Tare is an Allowance made to the Buyer for the Weight of the Bag, Cask, Chest, Wrapper, &c. into which Goods are put.

Tret is an Allowance made by the Merchant to the Buyer of 4 lb. in 104 lb. for Waste and Dust in some Sort of Goods.

Cloff is another Allowance of 2 lb. for every 3 Cwt. for the turn of the Scale; but this is allowed only in some particular Things and Cafes.

Note, The whole Weight, before any Allowances are made, is called Gros; when Part is deducted, the Remainder is called Suttle; but when all are taken from it, what's left, is called Neat,

E X A M P L E I.

I demand the neat Weight of 99 C. 2 qrs. 12 lb. gros.

Tare 14 lb. per 112 lb.

14 lb. is— $\frac{1}{8}$ 99 2 12 gros Weight,

12	1	22	$\frac{1}{2}$	Tare.
----	---	----	---------------	-------

87 0 17 $\frac{1}{2}$ neat Weight,

I N S T R U C T I O N.

Whatever Tare is allowed, if it be the even Part or Parts of an C. wt. the whole gros Weight must be divided by the said Part or Parts, and the Quotient thence arising gives the Tare of the whole; which subtract from the whole Gros, the Remainder is the neat Weight; as in the Example above, the gros Weight is divided by 8, (because 14 lb. is the eighth Part of an C.) and it gives 12 C. 1 qr. 22 $\frac{1}{2}$ lb. which, subtracted from the Gros, leaves the neat Weight.

Note, If Tret had been allowed along with the Tare in the above Question, after subtracting the Tare from the Gros, the Remainder would then have been Suttle, and that Suttle divided by 26, (because 4 lb is the 26th Part of 104 lb.) would have given the Tret, which must have been subtracted from the Suttle to find the neat Weight.

T A R E *and* T R E T.

55

In Hogheads of Tobacco, each C. qrs. lb.
Gross. Tare per Hoghead, how much neat Weight ?

What's the neat Weight of C. qrs. gross.
Tare per C. Weight ?

What's

What's the neat Weight of C. qrs. lb.
 Tare per C. Tret, 4 lb. per 104 lb.

What's the neat Weight of C. qrs. lb.
 Tare per C. Tret, 4 lb. per 104 lb. and Cloff 2 lb. for
 every 3 C. Weight?



T H E
G O L D E N R U L E:
O R, T H E
R U L E O F T H R E E D I R E C T.

This Rule teacheth from three Numbers given, to find out a fourth, which shall bear such Proportion to the second, as the third doth to the first.

For the Work of this Rule, reduce your first and third Numbers into one Name, and your second Number into the least Denomination mentioned; then multiply your second and third Numbers together, and divide the Product by the first, the Quotient is the Number sought, in such Denomination, as your second Number was reduced to.

Q U E S T I O N S.

If 3 lb. of Sugar cost 1s. 6d. what will 96 lb. cost?

<i>lb.</i>	<i>s. d.</i>	<i>lb.</i>
If 3	: 1 6	: : 96
	12	18
	18	768
		96
		3 1728
		12 576
		2 0 4,8
		2,8

l. s.
Ans. 2 8

58 THE RULE OF THREE DIRECT.

If 3 lb. of Tobacco cost 1¹/₆ what will 96 lb. cost?

If buy 1 Yard of Cloth, how many Yards will cost?

I N S T R U C T I O N.

In the stating of all Questions in the Rule of Three, set that Number in the Question which is of the same Species with the Number sought, in the second Place; that which gives it, in the first; and the third in Course will set itself. In the first Example, Money being demanded, 1s. 6d. which is of the same Species with the Number sought, is set in the second Place; and 3 lb. of Sugar, which gives it, in the first; then consequently 96 lb. must stand in the third Place. The Numbers being thus disposed, viz. the first and third made of one Name, and the second reduced into the lowest Denomination, I then proceed to multiply the second and third Numbers together, and divide by the first, which quotes 576 d. equal 2l. 8s.

Note, When you can reduce your first and second, or first and third Terms, into smaller ones without a Remainder, by taking an equal Part of both, the Work may be greatly abridged: As for Example, if 24 Yards cost 96 Crowns, how many will 36 Yards cost? Answer, 144 Crowns. Here, instead of 24 and 36, the first and third Terms, take the $\frac{1}{3}$ of each, and you will have 4 and 6 for the first and third Terms; by which multiply and divide, and the Answer will be the same as if 24 and 36 had been made Use of. Observe, that the three Terms must never all be reduced together; only the first and second, or the first and third. In this Case, if the first and second Terms be reduced to 3 and 12, or to 1 and 4, the same Answer will be produced by the Operation.

THE RULE OF THREE DIRECT. 59

If a Pound of Candles cost
Dozen cost ?

what will

If in

Days I spend

how many

will it come to in a Year ?

A Soldier's weekly Pay is s.
Years, Months,

due to him ?

d. which is forborn for
Days, what then is

If

60 THE RULE OF THREE DIRECT.

If I lay up yearly Marks out of an Estate of
l. s. d. per ann. I demand what I may
spend daily out of the Remainder to the Year's End ?

At per Week, how many Months Board may I have
for

If I buy Cloth for per Yard, and sell it again at
what shall I gain by laying out l.

What

THE RULE OF THREE DIRECT. 61

What Quantity of Pepper at per lb. may I have in Re-
turn for lb. of Tobacco, at per C. wt.

What's the Price of the Neat Weight of C.
Quarters Gross, at per lb. Tare, per C. wt.

A Merchant sends abroad Pieces of broad Cloth, each
Piece containing Yards, at per Yard, and ex-
pects, in Return, the one Half in Brandy, at
per Hoghead, and the other Half in Lemons, at
per Chest, what Quantity of each must he have ?

If

62 THE RULE OF THREE DIRECT.

If 12 lb. of Tea be worth 21 lb. of Chocolate, and 3 lb. of Chocolate cost s. d. how much will
1 lb. of Tea cost ?

How much will pay a Regiment of Soldiers, consisting of
Men for Months, at per Day each Man ?

PROOF *of the* GOLDEN RULE.

To prove your Work, multiply the fourth Number by the first ; and if that Product be equal to the Product of the second and third, the Work is right, otherwise not.

T H E

T H E INDIRECT RULE OF THREE.

If the Term which asketh the Question be less and require more, or more and require less, then is it the Indirect Rule of Three, and is performed by multiplying the first Number and second together for a Dividend, and dividing by the third, the Quotient is the Answer required.

Q U E S T I O N S.

If 9 Men can finish a Piece of Work in 30 Days, in how many Days will 15 Men do the same ?

Men. Days. Men.

If 9 : 30 : : 15

9

15)270(18

15

Ans. 18 Days.

120

120

...

...

I N S T R U C T I O N.

As in the Rule of Three Direct, so here also, the first and third Numbers must be of the same Name or Denomination, and the fourth Number, or Answer, will be of the same Name as the second, the Demand always laying upon the third; as in the above Example, 'tis demanded how long 15 Men will be doing the same Work that 9 Men does in 30 Days. Now, we may here very reasonably conclude, that the 15 Men, being the greater Number, must do it in less Time: Therefore, this being more and requiring less, I know it to be a Question in the Inverse Rule of Three; so multiply the first and second together, and divide by the third, the Quotient is 18 Days; in which Time the 15 Men will finish the like Work that 9 Men did in 30 Days

64 THE INDIRECT RULE OF THREE.

If for the Hangings of a Room there be used	Yards
of Paper,	Inches broad, how many Yards will it re-
quire of	in Breadth ?

If a Board is	Inches broad, how much in Length
will make a Foot Square of the same ?	

How many Yards of Silk, three Quarters broad, will line
Yards of broad Cloth that is two Yards broad ?

THE INDIRECT RULE of THREE. 65

If when the Price of a Bushel of Wheat is 2 s. 3 d. the Penny
Loaf weighs Ounces, what must the Penny Loaf weigh,
when the Price of a Bushel of Wheat is s. d ?

A Castle having in it Men, hath Provisions only suf-
ficient for Months, how many Men must be sent out, that
the same Provisions may serve Months ?

If James borrowed of Peter Pounds for
Months, how much should James lend to Peter for
Months, to requit his Favour ?

PROOF of the INDIRECT RULE OF THREE.

Multiply the first and second Terms together, and that Product
will be equal to the Product of the third and fourth Terms.

T H E COMPOUND RULE DIRECT.

In this Rule five Terms are given in the Question to find a sixth, which must bear such Proportion to the fourth and fifth, as the third bears to the first and second. In all Statings make the first Number of the same Name as your fourth ; your second Number the same Name as your fifth ; and your third, or middle Number which governs the Question, must always be of the same Name of the Answer required ; then multiply the three last Numbers together for a Dividend, and the two first for a Divisor, the Quotient will be the Answer.

Note, Questions in this Rule may also be answered by two Statings in the Single Rule of Three.

E X A M P L E S.

If 100 l. in twelve Months gain 6 l. Interest, what Interest will 75 l. gain in nine Months ?

<i>l.</i>	<i>mo.</i>	<i>l.</i>	<i>l.</i>	<i>mo.</i>
If 100	— 12	— 6	— 75	— 9
<u>12</u>			<u>9</u>	
			855	
			6	<i>l. s. d.</i>
			1200) 5130	(4 5 6 Anf.

I N S T R U C T I O N.

The five given Numbers in the Example above, consist of two Parts, viz. a Supposition and a Demand. The Supposition is contained in the first three Numbers, that is, 100, 12, and 6 ; for it is said, if 100 l. in twelve Months gain 6 l. Interest : And the Demand lieth in the two last, viz. 75 and 9 ; for it is demanded, how much 75 l. will gain in nine Months : Then in stating all Questions in this Rule, remember to set that Number which is of the same Species with the Number sought in the third Place ; that which gives it, in the first ; the Number common to both, in the second ; and that which is of the same Species with the first Number, in the fourth Place ; the fifth Number in Course will set it self.

THE COMPOUND RULE DIRECT. 67

If 2l. 10s. pay the Wages of nine Men for a Week, how much will pay the Wages of forty Men for thirty Days?

If 640 Bushels of Oats serve 420 Horses five Days, how many Bushels will serve 800 Horses for Days?

T H E

COMPOUND RULE INVERSE.

Having observed the same Rule here as in the Compound Rule Direct, that is, making the first and fourth, and second and fifth Numbers of like Name; proceed then to multiply the second, third, and fourth Numbers together for a Dividend, and the first and fifth together for a Divisor, the Quotient will be the Answer required in the same Name or Denomination of the middle Number.

E X A M P L E.

If 50 Men in six Days build a Wall 30 Yards in Length, how many Men will build a Wall 200 Yards long in three Days?

THE COMPOUND RULE INVERSE. 69

If for 20d. when the Tun costs 72l. you have two Pints of Wine, how many Pints may you have in Proportion for 30d. when the Tun costs but 1?

If 20l. gain 16l. in 15 Months, what Sum of Money will gain 24l. in Months?

PRACTICE.



P R A C T I C E.

This Rule is a Contraction of the Rule of Three, when a Question of the said Rule hath its first Number, consisting of One, or an Unit.

The TABLES.

The Aliquot, or even Parts of a Shilling.

6d.	4d.	3d.	2d.	1½d	1d.	¾d.	½d.	¼d.
$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{24}$	$\frac{1}{48}$

The even Parts of a Pound.

10s.	6s. 8d.	5s.	4s.	3s. 4d.	2s. 6d.	2s.	1s. 8d.	1s. 4d.
$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{12}$	$\frac{1}{15}$

1s. 3d.	1s.	8d.	6d.	4d.	3d.	2d.	1d.
$\frac{1}{18}$	$\frac{1}{20}$	$\frac{1}{30}$	$\frac{1}{40}$	$\frac{1}{60}$	$\frac{1}{80}$	$\frac{1}{120}$	$\frac{1}{240}$

The even Parts of a Hundred Weight.

56lb.	28lb.	16lb.	14lb.	8lb.	7lb.
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{7}$	$\frac{1}{8}$	$\frac{1}{14}$	$\frac{1}{16}$

What

What will 9876 oz. cost, at $\frac{1}{4}$ d. per Ounce?

$$\begin{array}{r}
 4) 9876 \\
 \hline
 12) 2469 \\
 \hline
 2 \mid 0) 205-9 \\
 \hline
 \text{Ans. L. } 10-5-9
 \end{array}$$

What will 9743 oz. cost, at $\frac{1}{2}$ d. per oz.

$$\begin{array}{r}
 2) 9743 \\
 \hline
 12) 4871-\frac{1}{2} \\
 \hline
 2 \mid 0) 40,5-11 \\
 \hline
 \text{Ans. L. } 20-5-11\frac{1}{2}
 \end{array}$$

I N S T R U C T I O N S.

1. When the Price of the Integer is Farthings, take the Aliquot Parts of that Price contained in a Penny, which must be Divisors to the given Number, and the Quotient will be Pence, which divided by 12 and by 20, gives Shillings and Pounds.

2. When the given Price is Pence, if it be the Aliquot or even Part of a Shilling, divide the given Quantity by the Number answering thereto, and the Quotient is Shillings; but when the given Price is Pence, or Pence and Farthings, and not the even Part of a Shilling, it must then be divided into even Parts, and the Quotients added together will be the Answer in Shillings.

3. When the given Price is such a Number of Shillings, or Shillings and Pence as make an even Part of a Pound, divide the given Quantity by that even Part, and the Quotient will be Pounds: Or; when the Price is Shillings and Pence; or Shillings, Pence, and Farthings, and not the even Part of a Pound, first take for such Shillings as are the even Part of a Pound, then for the remaining Shillings you may either take for them as before out of the given Number; or, which is as well, take an even Part of the Number produced by the former Division, (regard being had to the Value of the aliquot Part it came from) to make up those you want. After that, you may take an even Part of the Sum produced

What will 9438 oz. cost, at
 $\frac{3}{4}$ d. oz.

What will 8742 lb. cost, at
per lb.

What will 9076 lb. cost, at
1 d. per lb.

What will 8432 lb. cost, at
per lb.

duced for the least Number of Shillings for the Pence you want ; and for the Farthings an even Part of that produced by the Pence. And lastly, adding all together, the Sum will be the Answer in Pounds, &c.

4. When the Price of the Integer is Pounds, with Shillings, Pence, and Farthings, multiply the Quantity given by the Number of Pounds, and for the Shillings, Pence, and Farthings, proceed as before directed.

5. The Value of the Remainder is always equal to so many Times the Sum you take the aliquot Part for. As for Instance, if you divide by $\frac{1}{6}$ for 3 s. 4 d. and 5 should remain, then the Value thereof would be $\frac{5}{6}$ of a Pound, or 5 Times 3 s. 4 d. = 16 s. 8 d. And when it happens, as it frequently does, that you are obliged to take an even Part of a Sum drawn from the given Quantity to make up what you want ; in this Case observe, that the Remainder will always be so many Parts of a Pound, if the Sum divided be Pounds ; or so many Shillings, if Shillings be divided ; and not so many Times the Value of the aliquot Part ; the Remainder from the given Quantity being only so many Times the Value of the aliquot Part you divided for.

What

P R A C T I C E.

73

What will 8274 lb. cost, at
per lb.

What will lb. cost,
at per lb.

What will lb. cost,
at per lb.

What will Yards cost,
at per Yard ?

What will lb. cost,
at per lb.

What will Yards cost,
at per Yard ?

What will lb. cost,
at per lb.

What will Yards cost,
at per Yard ?

K

What

What will *158* Ells cost,
at *7. 1. 3/2* per Ell?

What will *45* Stone cost,
at *2. 2* per Stone?

What will *~* Ells cost,
at per Ell?

What will Stone cost,
at per Stone?

What will Ells cost,
at per Ell?

What will Stone cost,
at per Stone?

What will Ells cost,
at per Ell?

What will Gallons cost,
at per Gallon?

What

What will *100* Gallons
cost, at per Gallon?

What will Hogheads
cost, at
per Hoghead?

What will Hogheads
cost, at
per Hoghead?

What will Cwt. cost,
at per Cwt.

What will Hogheads
cost, at
per Hoghead?

What will Cwt. cost,
at per Cwt.

What will Hogheads
cost, at
per Hoghead?

What will Cwt. cost,
at per Cwt.

What

What will at	Cwt. cost, per Cwt.	What will the neat Weight of Cwt. Gross cost, at per Cwt. Tare lb. per 112 lb.
What will the neat Weight of Cwt. Gross cost, at per Cwt. Tare lb. per 112 lb.	cost, at Tare	What will the neat Weight of Cwt. qrs. Gross per lb. per Cwt.

I N T E R E S T.

Interest is either Simple or Compound.

Simple Interest is that which ariseth from the Principal only: Compound Interest arises from both Principal and Interest; and is therefore called Interest upon Interest; but this is seldom allowed, except in some particular Agreements.

S I M P L E I N T E R E S T.

What's the Interest of $L. \quad s.$
420—10 for a Year, at 5 per Cent.

$$\begin{array}{r}
 \text{L.} \quad \text{s.} \\
 420-10 \\
 \underline{5} \\
 21)02-10 \\
 \underline{20} \\
 0 \mid 50 \\
 \underline{12} \\
 6 \mid 00
 \end{array}
 \qquad
 \begin{array}{r}
 \text{L.} \quad \text{s.} \quad \text{d.} \\
 \text{Ans. } 21 \quad 0 \quad 6
 \end{array}$$

I N S T R U C T I O N S.

1. To find the Interest of any given Sum for a Year, multiply the Principal by the Rate per Cent. and instead of dividing by 100, cut off two Figures towards the Right-hand, and the Figures towards the Left are Pounds Interest; then multiply the two Figures cut off towards the Right-hand (being the Remainder) by 20, taking in the odd Shillings, and, cut off as before, the Figures on the Left are Shillings; so proceed to multiply the Remainder by 12 and by 4, still cutting off two Figures, and you have Pence and Farthings.

2. When the Principal is put out for Years and Months, find the Interest for the Years first, and take the Months as even Parts of a Year; but if the Time be odd Weeks, or Days, find the Interest by a second Stating in the Rule of Three, making a Year, or 365 Days, your first Term.

3. When $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$, are given along with Pounds in the Rate per Cent. multiply first by the Pounds given in the said Rate, and let the Parts for $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, &c. be taken from the Principal, and added to that Product; then cut off two Figures, and proceed as before.

If

78 SIMPLE INTEREST.

If 100l. in one Year's Time gain Interest, what will
 l. gain in the same Time ?

What is the Interest of for Years,
 Months, at per Cent. per Ann.

What is the Interest of for Years,
 Months Days, at per Cent. per Ann.

What's

SIMPLE INTEREST.

79

What's Week's Interest of at
per Cent.

What's the Amount of for
Years, at per Cent. per Ann.

What's the Amount of for
Years, at per Cent. per Ann.

COMPOUND INTEREST.

Compound Interest arises from both Principal and Interest ; and is therefore called Interest upon Interest.

What will 1000l. amount to in three Years, at 4l. per Cent. per Ann. Compound Interest?

10042.020



I N S T R U C T I O N.

Find the Simple Interest of the given Sum for the first Year, and make that Sum, and the former Principal, the Principal for the second Year, and find the Amount of that Principal for the second Year; then find the Principal and Interest for the third Year in the like Manner; and so on for any Number of Years given.

What

COMPOUND INTEREST.

8r

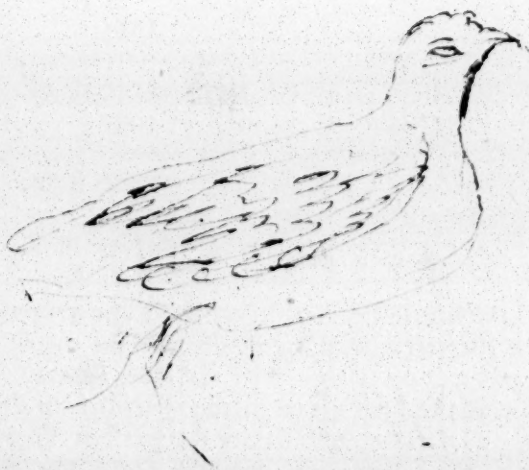
What is the Compound Interest of
per Cent. per Ann.

at



What is the Compound Interest of
per Cent. per Ann.

at



L.

. R E.

REBATE OR DISCOUNT.

By Rebate or Discount, is meant when a Sum of Money due at any Time to come is satisfied by paying down so much present Money, which being put out after the same Rate per Cent. and for the same Time would amount to the given Sum.

What is the Discount upon a Note of 157 l. due 9 Months hence, at 5 per Cent.

Y. M. L. M.
If 1 or 12 — 5 — 9
 5

12) 45 (3 l. 15 s.
 36

Rem. 9 = 15 s.

Then if 103 l. 15 s. — 3 l. 15 s. — 157 l.

 20 20
Or if 2075 s. — 75 s. — 157 l.
 75

785
1099

2075) 11775 (5 l. 13 s. 5 d. $\frac{1}{4}$ the
 10375 Anf.

1400 Rem.

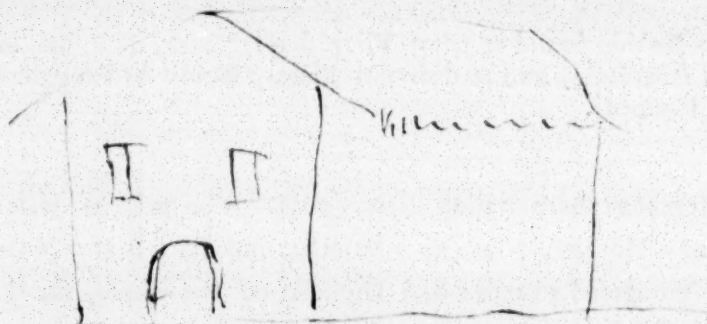
I N S T R U C T I O N S.

1. Find the Interest of 100 l. for the Time proposed in the Question, which Interest added to 100 l. will be the first Term in your Stating; the second Term must be the Interest alone; and the third Term is the Sum given in the Question to find the Rebate or Discount. If you want to know the present Worth, subtract the Rebate from the given Sum, or make 100 l. the second Number in the Stating.

2. The

REBATE OR DISCOUNT. 83

Bought Goods to the Value of _____ on _____
 Months Discount, at _____ per Cent. per Ann. what must
 be paid down ?



If I have a Prize of _____ drawn in the State Lottery,
 which is payable _____ Months after, how much must I re-
 ceive when I allow _____ per Cent. for present Payment ?

2. The Value of the Remainder is found by multiplying by 20, 12, and 4, and dividing each Time by the former Divisor.

N. B. Why the first and second Terms are Shillings, and the third Pounds, and the Quotient thence arising Pounds, see the Note in Page 58.

EQUA.

EQUATION OF PAYMENTS.

By this Rule is found at what Time several Sums that are to be paid separately, and at different Times, should be brought into one Payment.

A Merchant hath owing him 1250l. to be paid as follows: 300l. at 6 Months, 700l. at 4 Months, and the rest at 3 Months, but as 'tis agreed to make one Payment of the whole, the Time is demanded?

L.	L.	L.
300	700	250
6	4	3
Whole Debt 1800	2800	750
	750	
	1800	

1250) 5350 (4 Months and 8 Days the
5000 Answer,

350 = 8 Days.

I N S T R U C T I O N.

Multiply each Sum by the Time, and add their Products together, which divide by the whole Debt, and the Quotient will shew the equated Time.—The Value of the Remainder is found by multiplying it by 30 for the Days in a Month, and dividing as before.

A

EQUATION OF PAYMENTS. 85

A owes B a certain Sum of Money, which is to be discharged at three several Payments, that is, $\frac{1}{2}$ at Months, $\frac{1}{4}$ at Months, and $\frac{1}{4}$ at Months, but they agree to reduce them to one Payment, when must the whole be paid?

A Merchant bought Goods to the Value of
upon the following Conditions, viz. $\frac{1}{2}$ to be paid in
Months, and the Remainder in Months : I demand the
equated Time.

B A R T E R.

Barter is a Rule by which Merchants exchange Goods of several Prices and Quantities, and teacheth so to proportion them as that neither Party may sustain Loss.

How much Tea, at 5 s. per lb. must be given in Barter for 3 C. of Sugar, at 8 d. per lb.

3 Cw.

$$\begin{array}{r} 4 \\ \hline 12 \\ 28 \\ \hline 96 \\ 24 \end{array}$$

8 d. = $\frac{1}{30}$) 336 at 8 d. per lb.

L. 11 — $\frac{6}{30}$ = 4s.

lb. l. s.
If 5 s. — 1 — 11 — 4

20

5 | 224

44 — $\frac{4}{5}$ lb. the
Answer,

I N S T R U C T I O N.

All Questions in this Rule may be solved by the Single Rule of Three, or by Practice, when the first Term consisteth of one, or an Unit. In the Question above, the Price of the 3 C. of Sugar is first found by Practice to be 11 l. 4s. then the next Thing to be considered is, How much Tea this Sum will buy at 5 s. per lb. which is, by a Rule of Three Stating, found to be 44 $\frac{4}{5}$ lb. as above.

A

A barter'd Hogheads of Tobacco, each weighing
 C. qrs. at per lb. with B for
 Hogheads of Brandy : How did B rate his Brandy per
 Gallon ?

A and B barter ; A hath Yards of Cambrick, worth
 per Yard, for which B giveth him in ready Money
 l. and Cwt. of Pepper : How did B rate his
 Pepper per lb.

C and D barter ; C hath Gallons of Brandy,
 worth per Gallon ready Money ; but in Barter he
 will have per Gallon ; D hath Serge worth
 per Yard ready Money. The Question is, how many Yards of
 Serge D must give C for his Gallons of Brandy ?

LOSS AND GAIN.

By this Rule we discover what is got or lost per Cent. in selling and buying Goods, &c.

If I buy Candles at 5 d. $\frac{1}{2}$ the Pound, and sell them again for 6 d. $\frac{1}{4}$, What is gained per Cent.

$\begin{array}{r} d. \quad q. \quad l. \\ \text{If } 5 \frac{1}{2} - 3 - 100, \\ \underline{4} \\ 22 \end{array}$	or	$\begin{array}{r} q. \\ 96000 \\ \underline{3} \\ 22 \end{array}$	$\begin{array}{r} qrs. \quad l. \quad s. \quad d. \\ 13090 = 13 \quad 12 \quad 8 \frac{1}{4} \\ \text{the Answer.} \end{array}$
		$\begin{array}{r} 22 \quad 288000 \\ \underline{22} \\ 68. \\ 66 \\ \underline{\quad} \\ 200 \\ 198 \\ \underline{\quad} \\ 20 \end{array}$	

INSTRUCTION.

In this Rule it is often required how much is gained or lost per Cent. at the Price the Goods are sold at ; that is to say, How much Profit would be got, admitting 100l. were taken for Goods sold at the Rate proposed? To answer this, you are to consider how much the Sum given for any Quantity gains ; and then say, if that Sum gains so much, How much will 100l. gain? The other Parts of this Rule, being so very easy, that a farther Explanation is thought needless.

When there is Loss in the Case, it is proportioned in the like Manner, viz. if the Sum given lose so much, What will 100l. lose, &c.

If

LOSS AND GAIN.

89

If I buy
it again for
per Cent.

Cwt. of Tobacco for 4*l*. 13*s*. 4*d*. and sell
per lb. Whether do I gain or lose, and what

If I buy Cloth for
gain 20*l*. per Cent.

per Yard, How must I sell it to

If I have Goods to the Value of and am obliged
to sell them at per Cent. Loss, what come they to?

IN

SINGLE

SINGLE FELLOWSHIP.

Single Fellowship is when the Stock of each Partner continues for an equal Term, or Length of Time in Trade, and is perform'd by this Proportion.

As the Sum of the several Stocks
Is to the whole Gain or Loss;
So is each Man's particular Stock,
To his Share of the Gain or Loss.

E X A M P L E.

Three Merchants make a joint Stock; A puts in 400l. B 480l. and C 520l. they gained 300l. What is each Man's Share?

	L.	L.	L.
A's Stock	400		
B's Stock	480		
C's Stock	520		
		If 1400	300 400
			400
		14 00)	1200 00(
		A's Gain L.	85 14 3 $\frac{1}{4}$ 1 $\frac{1}{2}$

Total	1400		
	L.	L.	L.
If	1400	300	480
			300

	14 00)	1440 00(
B's Gain L.	102 17 1 $\frac{1}{2}$	1 $\frac{1}{4}$

L.	L.	L.
If 1400	300	520
		300

14 00)	1560 00(
----------	------------

C's Gain L.	111 8 6 $\frac{3}{4}$ 1 $\frac{1}{4}$
-------------	---------------------------------------

	Proof.
A's Gain	85 14 3 $\frac{1}{4}$ 1 $\frac{1}{2}$
B's ditto	102 17 1 $\frac{1}{2}$ 1 $\frac{1}{4}$
C's ditto	111 8 6 $\frac{3}{4}$ 1 $\frac{1}{4}$

Whole Gain L. 300 0 0

I N S T R U C T I O N S.

1. In this Rule there must always be as many Statings in the Rule of Three, as there are Partners in the Question; as in the Example above, there being but three Partners, three Statings are only necessary to shew each Partner's particular Gain. In all the Statings

SINGLE FELLOWSHIP. 95

Four Gentlemen fitted out a Privateer, which took Prizes to the Amount of _____ of which the first was to have $\frac{1}{3}$, the second $\frac{1}{4}$, the third $\frac{1}{5}$, and the other $\frac{1}{6}$. Now, on dividing the Spoil, they found they had a considerable Sum left, after each had received his Share as above. Quere, How much must each have of the whole ?

Statings in this Rule, the Sum of the several Stocks is the first Term, the whole Gain or Loss the second, and the third is one Man's particular Stock, and the Sum arising from the Operation his Gain or Loss respectively.

2. In all Cases where the several Shares fall short of the Sum gained, or to be divided, (or where they exceed it) as in the second Question, the best Way, is to find out a Number that will answer to all the Parts or Shares, or one that is the Multiple of the under Part of the Fraction of all the Shares given, (the smallest Number is the most convenient) then say, as the Sum of the Parts of the said Number is to the Number itself; so is any one of the Parts of the given Number to its Proportion of the whole respectively.

3. This Rule is proved by adding the Answers of the several Operations, or all the Partners particular Gain or Loss together, into one Sum; which, if it agree with the Sum gained or lost, the whole is right; if it does not, some Error has escaped your Notice in the Operation.

FOUR

92 SINGLE FELLOWSHIP.

Four Men are in Partnership, viz. A, B, C, and D.

A's Stock is	—	—	—
B	—	—	—
C	—	—	—
D	—	—	—

They lost in Trade
sustain of the said Loss ?

What must each Partner

Three Merchants in Company, A, B, and C, bought a Quantity
of Brandy, which cost them and they sold it again
for Now A gave towards buying it,
B and C How much is each Man's Share
of the Gain ?

DOUBLE

DOUBLE FELLOWSHIP.

Double Fellowship is when each Man's Stock has Relation to a particular Time ; and after multiplying each Man's Stock and Time together, and adding the several Products thence arising, the general Proportion will be, viz.

As the total Sum of the Products
Is to the whole Gain or Loss ;
So is each particular Product
To its Share of the Gain or Loss.

A, B, and C, being in Partnership, A put in for
Months, B for Months, and C for
Months, and they gain'd How must it be divided ?

I N S T R U C T I O N.

In this Rule, great Care must be taken to reduce all the particular Times (if not so given) into one Name, (i. e.) all into Years, all Months, all Weeks, or all Days, &c. then proceed as in Single Fellowship. This Rule is likewise proved in the same Manner as the former.

Three

94. DOUBLE FELLOWSHIP.

Three Merchants join in Trade : A put in for
Months, B for Months, and C for
Months ; but by Misfortune they lost What must each
Man sustain of the Loss ?

A and B in Company : A put in the first of January 1.
but B could not put any in till May-day following ; What must
B then put in to have an equal Share with A, at the End of twelve
Months ?

EXCHANGE.

E X C H A N G E.

As the Nature of Exchanges has been copiously and distinctly handled by many able Accountants; I shall therefore only give two or three Examples of the Exchanges of England, with some of the principal Places abroad.

In Spain they keep their Accompts in Rials and Marevedies, and exchange generally by the Piaſtre, England giving an uncertain Number of Pence and Parts for the ſaid Piaſtre.

34 Marevedies make 1 Rial.

8 Rials — — 1 Piaſtre.

A Merchant at Madrid ſends over Goods to London to the Value of Piaſtres Rials, Exchange at $40\frac{1}{2}$ d. per Piaſtre; How much Sterling Money will it amount to?

I N S T R U C T I O N.

In this Rule, obſerve to place the Rate of Exchange (whether of Engliſh or Foreign Money) in the ſecond Place; that is, of the ſame Species with the Demand in the Queſtion, and you cannot go wrong in the other Numbers; then proceed as in the Rule of Three. To find the Value of the Remainders, obſerve to multiply always by that Number of the lower Denomination, which makes one of the ſame Denomination with your ſecond Term, and divide by the former Diviſor, &c.

In Portugal they keep their Accompt in Reas, and exchange by the Mill-rea, 1000 Reas making 1 Mill-rea.

A Merchant of Oporto sends over to England a Quantity of Wine to the Value of *5070.7* Mill-reas, 240 Reas, Exchange at 5 s. 4 d. per Mill-rea ; how much Sterling Money does it amount to ?

In France they keep their Accompts in Livres, Sols, and Deniers, and exchange by the Crown or Ecu of 3 Livres.

12 Deniers make 1 Sol.

20 Sols — — 1 Livre.

3 Livres — — 1 Crown or Ecu.

A Bill of _____ is remitted to Lyons by a Merchant in Newcastle ; how much French Money will he have, Exchange at 31 d. per French Crown ?

In Holland, Flanders, and the Low Countries, some keep their Accompts in Guilders, Stivers, and Penningens; and others in Pounds, Schillings, and Pence Flemish, and exchange with us for our Pound.

16 Penningens make 1 Stiver.

20 Stivers — — 1 Guilder.

6 Stivers — — 1 Schilling.

6 Guilders — — 1 Pound Flemish.

A Bill of Exchange is remited from Amsterdam to London of Guilders, Exchange at 36s. 8d. Flemish, for 1 l. Sterling; how much English Money will it amount to?

At Leghorn and Genoa they keep their Accompts in Piaftres or Pezzos, Soldi and Denari; and Exchange with England, by the said Piaftre or Pizzo for Pence and Parts.

12 Denari make a Soldi.

20 Soldi a Piaftre or Pizzo.

A Merchant at Leghorn sent over Goods to England to the Amount of Piaftres, Exchange at $53\frac{1}{4}$ per Piaftre: How much Money has he due in England?



ALLIGATION MEDIAL.

This Rule teacheth us to find the mean Price of any Mixture, when we know the Quantities and Prices of the several Parts which compose it.

R U L E.

As the Sum of the Quantities,
Is to their total Value ;
So is any Part of the Compound,
To its mean Price.

E X A M P L E S.

A certain Person would mix sixty Gallons of White Wine at 5 s. 6 d. per Gallon, with fifty Gallons of Malaga at 7 s. 6 d. per Gallon, and forty Gallons of Madeira at 8 s. 9 d. per Gallon. I demand what a Gallon of this Mixture is worth ?

	<i>s.</i>	<i>d.</i>		<i>l.</i>	<i>s.</i>
60 Gallons of White Wine — — at	5	6	is	16	10
50 Gallons of Malaga — — —	7	6	—	18	15
40 Gallons of Madeira — — —	8	9	—	17	10
				150	Whole Measure.
Total Value				L. 52	15

Then if $\begin{array}{c} g. \\ 150 \end{array} \begin{array}{c} l. \\ 52 \end{array} \begin{array}{c} s. \\ 15 \end{array} \begin{array}{c} g. \\ 1 \end{array}$

$$\begin{array}{r}
 150 \overline{) 1055} \quad (7 \text{ s. } \frac{1}{4} \text{ d. the Answer,} \\
 \underline{1050} \\
 5 = \frac{1}{4} \text{ d.}
 \end{array}$$

I N S T R U C T I O N .

To solve this Question, and others of like Nature in Alligation Medial, first add together the given Quantities, and also their Values ; then state your Question as directed in the Rule above ; and proceeding by the Rule of Three Direct, you will find the mean Price.

ALLIGATION MEDIAL. 99

A Farmer would mix Bushels of Wheat at 6 s. 6 d. per
 Bushel, and Bushels of Barley at 4 s. 9 d. per Bushel, and
 Bushels of Rye at 4 s. per Bushel, and Bushels
 of Oats at 2 s. per Bushel. I demand the Price of a Bushel of this
 Mixture ?

A Merchant having four Sorts of Tea, would mix lb. at
 7 s. per lb. with lb. at 9 s. per lb. and lb. at
 12 s. per lb. and at 15 s. per lb. I demand the Price of
 a Pound of this Mixture ?



ALLIGATION ALTERNATE.

This Sort of Alligation is to be considered under three Varieties.

VARIETY I.

In this Variety the whole is in linking the Extremes truly together, and taking the Difference betwixt them and the mean; which Differences are the Quantities sought.

EXAMPLES.

A Grocer would mix Sugars, some at 8 d. per lb. some at 9 d. some at 11 d. and some at 1 s. per lb. so as to sell the Compound at 10 d. per lb. What Quantity of each must he take?

				Or thus,			
<i>d.</i>	<i>lb.</i>	<i>d.</i>		<i>d.</i>	<i>lb.</i>	<i>d.</i>	
	8 —	— 2 at 8	} Anf.		8 —	— 1 at 8	} Anf.
	9 —	— 1 at 9			9 —	— 2 at 9	
	11 —	— 1 at 11			11 —	— 2 at 11	
	12 —	— 2 at 12			12 —	— 1 at 12	
10 {				10 {			

INSTRUCTION.

The Prices of the Simples being placed one over the other in their due Order, and the propounded Price of the Composition against them, I then link the several Rates so, as that one may be greater than the Mean, or Price of the Compound proposed, and the other less; then take the Difference betwixt each Extreme and the mean Price, placing it against its opposite Yoke-fellow; and these Differences are the Quantities sought at their respective Rates.

Note, Questions in this Rule admit of great Variety of Answers, yet all true, which arise from as many different Ways of linking the several Rates together, as may be seen in the first Example.

ALLIGATION ALTERNATE. 101

A Farmer hath several Sorts of Wheat, one Sort at 25 s. per Load, another Sort at 21 s. another at 18 s. and another at 16 s. I desire to know what Quantity of each Sort he must take to make the Mixture worth per Load ?

A Merchant hath several Sorts of Goods, viz. one Sort at 1 s. 10 d. per lb. another at 1 s. 6 d. a third at 15 d. and a fourth at 1 s. per lb. how much of each Sort must he take, that he may sell a Pound for s.

102 ALLIGATION ALTERNATE.

VARIETY II.

In this Variety we have the Price of all the Simples with one given Quantity, to find the several Quantities of the rest, in Proportion to the Quantity given.

EXAMPLE.

A Grocer would with 40 lb. of Tea, at 12 s. per lb. mix it with Tea at 7 s. per lb. and Tea at 5 s. per lb. so as to sell the whole at _____ per lb. How much of the two last Sorts much he take to add to the other ?

INSTRUCTION.

Take the Differences between each Price and the mean Rate, and place them as in the first Variety ; then the several Quantities to be mingled with the given Quantity may be found by the following Proportion : As the Difference standing opposite the first Branch, is to the rest of the Differences severally ; so is the Quantity given, to the several Quantities required.

ALLIGATION ALTERNATE. 103

A Farmer would mix twenty Bushels of Oats at 16 d. per Bushel, with Barley at 2 s. 8 d. with Rye at 3 s. 6 d. and with Wheat at 4 s. 6 d. per Bushel : The Question is, How much Barley, Rye, and Wheat must be added to the twenty Bushels of Oats, that it may bear the Price of per Bushel ?

104 ALLIGATION ALTERNATE.

VARIETY III.

In this last Variety the Prices of the several Things are given with the mean Rate, to find how much of each Sort must be taken to make up the Quantity propounded.

EXAMPLE.

A Tobacconist having four Sorts of Tobacco, viz. at 1 s. per lb. at 15 d. per lb. at 20 d. per lb. and at 2 s. per lb. and he would have a Composition of an Cwt. worth per lb. I demand how much of each Sort he must have ?

INSTRUCTION.

After the Work of the first Variety is perform'd, to find the Quantity of each simple to make the whole Composition, you are to observe this general Rule : As the Sum of the Differences, is to the whole Quantity of the given Compound ; so is each particular Difference, to its particular Quantity sought.

VUL-



VULGAR FRACTIONS.

A Fraction, or broken Number, signifies the Part or Parts of a whole Number, and is expressed by two Numbers with a Line drawn betwixt them

Thus $\left\{ \begin{array}{l} 2 \text{ Numerator.} \\ \hline 3 \text{ Denominator.} \end{array} \right.$

The Number below the Line, called the Denominator, shews into how many Parts a Whole is divided; and the Number above the Line, called the Numerator, shews how many of these Parts the Fraction contains.

There are three Sorts of Vulgar Fractions, viz.

A proper Fraction $\frac{3}{4}$.

An improper Fraction $\frac{4}{3}$.

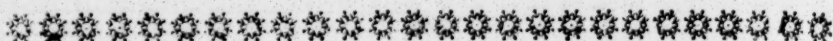
A Compound Fraction $\frac{1}{2}$ of $\frac{2}{3}$, &c.

Also a mixt Number, composed of a whole Number and a Fraction thus $8\frac{3}{4}$.

As Addition and Subtraction of Vulgar Fractions cannot well be performed without the Knowledge of Reduction, we shall first begin with it.

Note, The following Marks must be taken Notice of, and signify, viz. $\times$ more, or Addition; $-$ less, or Subtraction; $\times$ multiply, or Multiplication; $\div$ divide, or Division; $=$ equal to, or Equality; $:$ is to, or Proportion; $::$ so is.

106 VULGAR FRACTIONS.



REDUCTION of VULGAR FRACTIONS,

May be considered under nine Heads, or Cases, as follow :

I.

To reduce Fractions of divers Denominations into one of the same Value ; multiply each Numerator into all the Denominators, except its own, for a new Numerator, and all the Denominators together for a common Denominator.

E X A M P L E S.

Reduce $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{2}{8}$ to a common Denominator.

$$4 \times 6 \times 8 = 192 \text{ common Denom.}$$

$$3 \times 6 \times 8 = 144 \text{ 1st Numer.}$$

$$5 \times 4 \times 8 = 160 \text{ 2d ditto.}$$

$$2 \times 4 \times 6 = 48 \text{ 3d ditto.}$$

$$\begin{array}{r} \text{The Anf.} \quad \frac{144}{192} \quad \frac{160}{192} \quad \frac{48}{192} \end{array}$$

Reduce

to a common Denominator.

Reduce

to a common Denominator.

To

II.

To reduce a Fraction to its lowest Terms, equivalent to a Fraction given; divide the greater Term of the given Fraction by the lesser, and then proceed, continually dividing the last Divisor by the last Remainder till nothing remains: The last Divisor is the common Measure; by which divide both Parts of the given Fraction, and the Quotients are the lowest Terms of the Fraction sought.

Reduce $\frac{60}{84}$ to its lowest Terms.

$$\begin{array}{r} 60 \overline{) 84} (1 \\ \underline{60} \end{array}$$

$$12 \overline{) \frac{60}{84}} (\frac{5}{7} \text{ Answer.}$$

$$\begin{array}{r} 24 \overline{) 60} (2 \\ \underline{48} \end{array}$$

Common Measure $\begin{array}{r} 12 \overline{) 24} (2 \\ \underline{24} \end{array}$

Reduce $\frac{60}{84}$ to its lowest Terms,

Reduce $\frac{60}{84}$ to its lowest Terms.

III.

To reduce a mixt Number into an improper Fraction ; multiply the whole Number by the Denominator, and to that Product add the Numerator ; which Sum set over the former Denominator, shews the improper Fraction required.

Reduce $8\frac{3}{5}$ to an improper Fraction.

$$\begin{array}{r} 8 \\ 5 \\ \hline 40 \\ 3 \text{ Numer. add.} \\ \hline 43 \end{array}$$

The Answer. $4\frac{3}{5}$

Reduce to an improper Fraction.

Reduce to an improper Fraction.

Reduce to an improper Fraction.

IV.

To reduce an improper Fraction to a mixt Number, divide the Numerator by the Denominator, and set the Remainder over the Denominator.

Reduce $2\frac{4}{7}$ to a mixt Number.

$$7 \overline{) 24} (3\frac{3}{7} \text{ the Answer.}$$

21

3 Rem.

Reduce to a mixt Number.

Reduce to a mixt Number.

Reduce to a mixed Number.

V.

To reduce a compound Fraction to a single one, multiply all the Numerators for a new Numerator, and all the Denominators for a new Denominator.

Reduce $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{3}{5}$ to a single Fraction.

$$\begin{array}{r} 3 \\ 5 \\ \hline 15 \\ 3 \\ \hline \end{array}$$

45 Num.

$$\begin{array}{r} 5 \\ 6 \\ \hline 30 \\ 4 \\ \hline \end{array}$$

120 Denom.

The Answer $\frac{45}{120}$

Reduce $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{5}{8}$ to a single Fraction.

Reduce of of of of to a single Fraction.

Reduce of of of of to a single Fraction.

To

VULGAR FRACTIONS. 111

VI.

To reduce a Fraction of one Denomination to the Fraction of another, retaining still the same Value.

When the Fraction is brought from a lesser to a greater Denomination, make it a compound Fraction, by comparing it with the several Denominations between it and that which you would reduce it to; then reduce the compound Fraction to a single one.

Reduce $\frac{5}{8}$ of a Penny to the Fraction of a Pound.

$\frac{5}{8}$ of $\frac{1}{12}$ of $\frac{1}{20} = \frac{5}{1920}$ the Answer.

$$\begin{array}{r} 8 \\ 12 \\ \hline 96 \\ 20 \\ \hline 1920 \text{ Denom.} \end{array}$$

Reduce of a Penny wt. to the Fraction of lb. Troy.

Reduce of an Ounce to the Fraction of Cwt.

INSTRUCTION.

In this Case, $\frac{5}{8}$ of a Penny, being to be reduced to the Fraction of a Pound, I first consider that a Penny, is $\frac{1}{12}$ of a Shilling, and a Shilling is $\frac{1}{20}$ of a Pound; therefore I make a Compound Fraction of it, by saying $\frac{5}{8}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a Pound, which, reduced to a simple one, equals $\frac{5}{1920}$, as above; and so with any other, whether of Money, Weights, or Measures, regard being had to the several Denominations between the Species given and that required, respectively.

When

112 VULGAR FRACTIONS.

VII.

When a Fraction is brought from a greater to a lesser Denomination ; multiply the given Number, by the Parts of the Denominations between it, and that which you would reduce it to for a new Numerator, and place it over the given Denominator.

Reduce $\frac{3}{8}$ of a Pound to the Fraction of a Penny.

$$\frac{3}{8} \text{ of } \frac{20}{1} \text{ of } \frac{12}{1} = \frac{720}{8} \text{ the Answer.}$$

$$\begin{array}{r} 3 \\ 20 \\ \hline 60 \\ 12 \\ \hline 720 \end{array}$$

Reduce of a Pound Troy to the Fraction of a Penny wt.

Reduce of a Tun to the Fraction of a Stone.

INSTRUCTION.

This is but the Reverse of the former Case. Care must be taken that the Terms run in the descending Manner, viz. that all the Denominations, between the given one, and that to which you want to descend, be made Numerators ; then proceed as in Compound Fractions for the Answer, which will always be of the Denomination required in the Question.

To

VULGAR FRACTIONS. 113

VIII.

To find the Value of any Fraction in the known Parts of an Integer, multiply the Numerator by the Number of known Parts contained in the Integer, and divide the Product by the Denominator, the Quotient is the Answer.

What is the Value of $\frac{3}{4}$ of a Pound Sterling ?

$$\frac{3}{4} \text{ of } 20 = \frac{60}{4} = 15 \text{ s. the Answer.}$$

What is the Value of of a Pound Troy ?

What is the Value of of a Pound Avoirdupois ?

INSTRUCTION.

Here nothing more is necessary than what was observed in the last Case ; only the Numerator, as increased by the Parts of the Integer, must be divided by the old Denominator, and the Quotient thence arising will be the Answer in the Species of the Parts of the Integer ; as twenty Parts of a Pound being here used, the Answer is in Parts of one Twentieth, or Shillings.

When there happens to be a Remainder, proceed for the inferior Denominations as in whole Numbers, dividing by the Denominator, or old Divisor, for each Species.

IX.

Having a Sum or Quantity given to reduce it to a Fraction of a greater Denomination; reduce the Sum or Quantity given to the lowest Name mentioned for a Numerator; and also the integral Part into the same Name for a Denominator.

Reduce 7 s. 6d. to the Fraction of a Pound Sterling.

$$7 \text{ s. } 6 \text{ d.} = \frac{20}{40} \text{ d. or } \frac{3}{8} \text{ l. the Answer.}$$

Reduce	oz.	drs. to the Fraction of a Pound
Avoirdupois.		

Reduce	hhd.	galls. of Wine to the Fraction
of a Tun.		

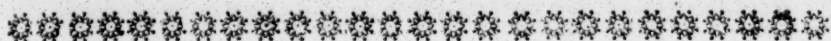
I N S T R U C T I O N.

This varies but little from Case 6th; and if Care be taken to reduce the Shillings and Pence all into Pence, or Shillings, Pence, and Farthings all into Farthings, and under the Number of the Pence or Farthings respectively, if the Pence or Farthings in a Pound be placed, the Work is done; only as the Fraction thence arising will be pretty large, it ought to be reduced to its lowest Terms; so in Weights and Measures, Regard being had to the different Denominations.

Note, To reduce a Fraction to its lowest Terms, see Case 2d, or proceed thus: Divide the Numerator and Denominator by any Number that will divide them both without a Remainder, and those Products again by any Number that will divide both equally, and so on till you can get no Number to reduce them lower. The two last Products, placed fraction-wise, still retain the same Value of the Fraction given.

A D-

VULGAR FRACTIONS. 115



ADDITION of VULGAR FRACTIONS.

What has been done in Reduction of Fractions, was chiefly to prepare Fractions of different Denominations to be added or subtracted as required: For if they be compound Fractions, they must be reduced to single ones; if of different Denominations, they must be brought into one Denomination, before they can be added or subtracted.

R U L E.

Reduce your Fractions to a common Denominator, (if they are not already so) and add all the Numerators together, their Sum will be a new Numerator, under which subscribe the common Denominator.

E X A M P L E S.

Add $\frac{3}{8}$, $\frac{1}{10}$, and $\frac{5}{16}$, together?

$8 \times 10 \times 16 = 1280$ the common Denominator.

To find the Numerator, say,

$3 \times 10 \times 16 = 480$ 1st Numerator.

$1 \times 8 \times 16 = 128$ 2d ditto.

$5 \times 10 \times 8 = 400$ 3d ditto.

1008 Sum of the Numerators.

Answer $\frac{1008}{1280}$, which may be

reduced to $\frac{63}{80}$

I N S T R U C T I O N.

Addition and Subtraction being the most difficult Parts in Vulgar Fractions, especially as those Operations cannot be perform'd till all the Fractions given are reduced to a common Denominator, great Care must be taken that this be done before the Numerators be added or subtracted.—After which, as this Operation will often occasion large Numbers, you must reduce them as low as may be, especially when you have Occasion to multiply or divide by them, which will save much Trouble, and the Answer thence arising be full as exact.

Add

116 VULGAR FRACTIONS.

Add

together.

Add

together.

Add

together.

Add

together.

SUB.



SUBTRACTION *of* VULGAR FRACTIONS.

When you have reduced the given Fractions to a common Denominator by the foregoing Rules of Reduction, subtract the lesser Numerator from the greater, and place it over the common Denominator.

E X A M P L E S.

From $\frac{1}{2}$ take $\frac{1}{6}$.

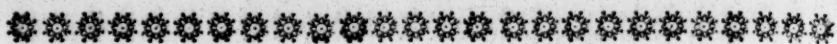
$\frac{1}{2} - \frac{1}{6} = \frac{2}{12}$, and $\frac{6}{12}$, then $2 - 6 = 12$, or $\frac{1}{3}$ the Answer.

From take

From take

From of take

118 VULGAR FRACTIONS.



MULTIPLICATION *of* VULGAR FRACTIONS.

Multiply the Numerators together for a new Numerator, and the Denominators together for a new Denominator ; which Numerator set over the Denominator, is the Product sought.

Multiply $\frac{7}{8}$ by $\frac{3}{4}$.

$$\frac{7}{8} \times \frac{3}{4} = \frac{21}{32} \text{ the Answer.}$$

Multiply by

Multiply by

Multiply by

Multiply by



DIVISION *of* VULGAR FRACTIONS.

Multiply the Numerator of the Dividend by the Denominator of the Divisor, for a new Numerator ; and the Denominator of the Dividend and Numerator of the Divisor together for a new Denominator.

Divide $\frac{2}{10}$ by $\frac{1}{5}$.

$$\frac{1}{5} \div \frac{2}{10} = \frac{4}{10} \text{ the Answer.}$$

Divide by

Divide by

Divide by

Divide by

I N S T R U C T I O N.

Observe to place the Divisor before the Dividend in the Operation, and further Directions will be needless, as the Parts of the Fraction of the Dividend do not change Place by the Operation, i. e. if the Numerator be used, it produces a new Numerator in the Quotient, &c.

The



The RULE OF THREE DIRECT *in* VULGAR FRACTIONS.

Prepare the Numbers by Reduction, and then work as in whole Numbers; multiply the second and third Fractions together; divide the Product by the first Fraction; and the Quotient is the Answer.

E X A M P L L S.

If $\frac{3}{5}$ of a Yard cost $\frac{2}{5}$ l. what will $1\frac{5}{7}$ Yards cost?

Y. L. Y.

$$\text{If } \frac{3}{5} - \frac{2}{5} - \frac{1^2}{7}$$

$$\frac{1^2}{7} \times \frac{2}{5} = \frac{2^4}{3^3} \text{ Then } \frac{3}{5} \div \frac{2^4}{3^3} = \frac{1^2 0}{10^3} \text{ the Answer.}$$

The Value of which will be 1 l. 2 s. 1 $\frac{1}{4}$ d.

If $\frac{2}{5}$ of an Ell cost $\frac{1}{3}$ of a Pound, what will an Ell cost? of

I N S T R U C T I O N.

The same Care must be taken that the Terms stand in due Order, and that the first and third be of one Species, as in the Rule of Three in whole Numbers. The second Term should always be kept in as high a Denomination as given in the Question, in order to shorten the Work. The fourth Term will be always of the same Species with the second Term; and the Value of it is found by dividing the Numerator by the Denominator for the Integers, and proceeding for the inferior Denominations, as in whole Numbers.

The

VULGAR FRACTIONS. 121

If $3\frac{1}{4}$ Yards of Cloth cost what will
Yard cost ?

A Mercer bought 5 Pieces and $\frac{1}{2}$ of Silk, each Piece containing
Yards, at per Yard: What cost the $5\frac{1}{2}$
Pieces ?

How many Yards of Velvet can I have for at the
Rate of per Yard ?

~~~~~

*The* INVERSE RULE of THREE in VULGAR FRACTIONS.

If 9 Men can finish a Piece of Work in  $30\frac{1}{3}$  Days ; in how many Days will 15 Men be in doing the same ?

M.            D.            M.  
If 9 —  $30\frac{1}{3}$  — 15

$$\frac{9}{1} \times \frac{91}{3} = 81\frac{2}{3}$$

Then  $\frac{15}{1} \div 81\frac{2}{3} = 8\frac{19}{42}$  the Anf. or 18 Days and  $\frac{29}{42}$ .

If for the Matting of a Room there be used  
Yard-broad ; how many Yards will it require of

Yards of  
broad ?

### I N S T R U C T I O N.

Here it may be worth observing, that the 1st and 3d Terms, being whole Numbers, are made improper Fractions, by placing Units under them, which must always be done in working with whole Numbers fraction-wise ; and that mixt Numbers, as  $30\frac{1}{3}$  above, must always be reduced to improper Fractions, before you can go on with the Operation ; then proceed according to the Inverse Rule of Three in Whole Numbers.

*The*

# VULGAR FRACTIONS. 123



The DOUBLE RULE of THREE in VULGAR FRACTIONS.

If 7 Labourers earn  $7\frac{3}{4}$  l. in 30 Days; how much will 18 Labourers earn in 6 Weeks?

*Answer*  


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|                                      |              |              |
|--------------------------------------|--------------|--------------|
| If the Carriage of                   | Cwt. cost me | for          |
| Miles; how much will the Carriage of |              | Tons cost me |
| for                                  | Miles?       |              |



## DECIMAL FRACTIONS.

A Decimal Fraction supposes the Integer to be divided into 10, 100, 1000 Parts, &c. without End, and is distinguished by a Point or Comma placed before it thus ,5 stands for  $\frac{5}{10}$ ,—,25 for  $\frac{25}{100}$ ,—,785 for  $\frac{785}{1000}$ , &c.

### NOTATION of DECIMALS.

As in whole Numbers their Value increases in a tenfold Proportion towards the Left-hand from the Units Place; so the Value of Decimals decreases in the same Proportion towards the Right, viz.

|                 |                                 |
|-----------------|---------------------------------|
| Integers. 5 , 5 | Five Tenth Parts of an Integer. |
| 50 , 05         | Five Hundred Parts.             |
| 500 , 005       | Five Thousand Parts.            |
| 5000 , 0005     | Five Ten Thousand Parts.        |
| 50000 , 00005   | Five Hundred Thousand Parts.    |

N. B. A Cypher, or Cyphers, placed on the Right-hand of a Decimal, neither increases or decreases its Value.

RE-





## REDUCTION of DECIMALS.

Reduction of Decimals may be considered under three Heads, viz.

### I.

To reduce a Vulgar Fraction to a Decimal, add a competent Number of Cyphers to the Numerator, and divide by the Denominator; the Quotient is the Decimal Fraction required.

What Decimal Parts are equal to  $\frac{5}{8}$ ?

8 ) 5,000 ( ,625 the Answer.

$$\begin{array}{r}
 48 \\
 \hline
 20 \\
 16 \\
 \hline
 40 \\
 40 \\
 \hline
 \end{array}$$

Reduce

to a Decimal.

Reduce

of

to a Decimal.

## I N S T R U C T I O N.

If it should happen to be an improper Fraction that is to be reduced to a Decimal; in that Case, there will arise some whole Numbers in the Quotient. To know the Value of the Quotient Figures, see Division.

# 126 DECIMAL FRACTIONS.

## II.

To find the Value of a Decimal in the known Parts of an Integer, multiply the given Decimal by the common Parts of the Integer, and cut off as many Figures from the Product, as there are Decimals given.

What is the Value of ,625 of a Pound Sterling ?

$$\begin{array}{r} 20 \\ \hline 12,500 \\ 12 \\ \hline 6,000 \end{array}$$

12 s. 6 d. the Answer.

What is the Value of                      of a Yard ?

What is the Value of                      of a Hoghead of Wine ?

What is the Value of                      of a Year ?

## INSTRUCTION.

Here no more Directions seems necessary than to proceed as in Reduction of whole Numbers, save that just as many Figures as the Number of Places of Decimals given be mark'd off in each Product to the Right-hand, before you proceed to a lower Denomination. The Figures left on the Left-hand, or cut off, are whole Numbers of each Species.

## III.

# DECIMAL FRACTIONS. 127

## III.

To reduce Shillings, Pence, and Farthings, or any other Denomination, to a Decimal.

Reduce 5 s. 4 d. to the Decimal of a Pound.

In a Pound 240 d. ) 64,0000 d. ( ,2666 the Answer.

$$\begin{array}{r}
 480 \\
 \hline
 1600 \\
 1440 \\
 \hline
 1600 \\
 1440 \\
 \hline
 160
 \end{array}$$

Reduce Inches to the Decimal of a Yard.

Reduce Perches to the Decimal of an Acre.

Reduce Hoghead. Gallons of Wine to the Decimal of a

## INSTRUCTION.

In this Case, the Sum given must be reduced into the lowest Denomination mentioned, and under it place the Number of the same Species contained in the Demand in the Question, which reduces it to a Vulgar Fraction, and then proceed as in the former Case.

A D.



## ADDITION of DECIMALS.

Addition and Subtraction of Decimals are perform'd the same Way as Integers, keeping all your Decimal Points directly below each other.

## EXAMPLES in ADDITION.

N<sup>o</sup> 1.
$$\begin{array}{r} 2,65 \\ 1,125 \\ ,4281 \\ \hline \end{array}$$

$$\begin{array}{r} 2,416 \\ 2,7 \\ 2,12 \\ \hline \end{array}$$

$$\hline 11,4391$$

$$\begin{array}{r} 27,473 \\ 36,25 \\ 9,23 \\ \hline \end{array}$$

$$\begin{array}{r} 138,36 \\ 87,189 \\ 243,28 \\ 38,9 \\ \hline 176,137 \\ \hline \end{array}$$
N<sup>o</sup> 2.
$$\begin{array}{r} 24,8 \\ 16,75 \\ 17,181 \\ \hline \end{array}$$

$$\begin{array}{r} 18,697 \\ 17,121 \\ 14,18 \\ \hline \end{array}$$

$$\begin{array}{r} 704,12 \\ 18,140 \\ 26,426 \\ \hline \end{array}$$

$$\begin{array}{r} 149,17 \\ 26,174 \\ 137,38 \\ 43,4 \\ \hline 287,125 \\ \hline \end{array}$$
N<sup>o</sup> 3.
$$\begin{array}{r} 48,031 \\ 76,121 \\ 143,04 \\ \hline \end{array}$$

$$\begin{array}{r} 53,173 \\ 28,032 \\ 8,24 \\ \hline \end{array}$$

$$\begin{array}{r} 71,321 \\ 9,20 \\ 17,23 \\ \hline \end{array}$$

$$\begin{array}{r} 36,23 \\ 9,8 \\ 18,346 \\ 8,27 \\ \hline 36,1378 \\ \hline \end{array}$$

## INSTRUCTION.

If in Addition and Subtraction Care be taken to place the Decimals properly, i.e. Tens under Tens, &c. to the Right-hand, you have only to proceed as in whole Numbers, observing always to cut off just as many Decimals, in the Total, or Difference, as are in the longest Line of your Question, as in Ex. 1, above, there being four Decimals in the third Line, four must be mark'd off in the Total.

SUB-



# DECIMAL FRACTIONS. 129



## SUBTRACTION *of* DECIMALS.

|       |        |          |          |
|-------|--------|----------|----------|
| From  | 48,461 | 721,3006 | 138,1287 |
| Take  | 9,12   | 48,143   | 27,083   |
|       | <hr/>  | <hr/>    | <hr/>    |
| Left  | <hr/>  | <hr/>    | <hr/>    |
| Proof | <hr/>  | <hr/>    | <hr/>    |

|       |          |       |          |
|-------|----------|-------|----------|
| From  | 2076,312 | 39,5  | 217,3762 |
| Take  | 48,144   | 7,876 | 96,00087 |
|       | <hr/>    | <hr/> | <hr/>    |
| Left  | <hr/>    | <hr/> | <hr/>    |
| Proof | <hr/>    | <hr/> | <hr/>    |

|       |          |         |         |
|-------|----------|---------|---------|
| From  | 1008,27  | 387,1   | 4870,   |
| Take  | 127,1987 | 43,8762 | 6,87608 |
|       | <hr/>    | <hr/>   | <hr/>   |
| Lefts | <hr/>    | <hr/>   | <hr/>   |
| Proof | <hr/>    | <hr/>   | <hr/>   |

R

MUL.

## MULTIPLICATION *of* DECIMALS.

Multiplication of Decimals is also perform'd the same Way as Multiplication of Integers, only observe to make as many Decimal Parts in the Product as there are in both Multiplicand and Multiplier; but, in case your Product has not so many Figures as there are decimal Places in the Multiplicand and Multiplier, prefix Cyphers on the Left-hand of the Product before you fix your decimal Point.

## E X A M P L E S.

$$\begin{array}{r} \text{Multiply} \quad 217 \\ \text{By} \quad 38 \\ \hline 1736 \\ 651 \phantom{0} \\ \hline 8246 \end{array}$$

Multiply      , 0 4 2 7 6 3  
By                      , 8 7

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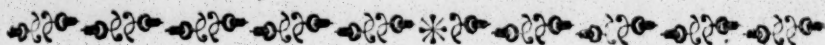
Multiply      37,96  
By

Multiply      4,8763  
By

## I N S T R U C T I O N.

In the Example above, after I have wrought the Question as in whole Numbers, I then consider how many Decimal Places I have to cut off in the Product, which, by observing the Multiplier and Multiplier, I find must be five: I therefore prefix a Cypher to the Left hand of it, and the Work is done.

D I.



## DIVISION of DECIMALS.

Division of Decimals differs nothing from Division of Integers, only Care must be taken to have as many Decimal Places in the Quotient, as the Dividend has more than the Divisor ; but if it happen there are not so many Figures in the Quotient, prefix Cyphers towards the Left-hand : Or, to know the Value or Denomination of the Quotient, always observe that the first Figure in the Quotient will be of the same Name with that Figure in the Dividend which stands over the Units Place, in the Divisor, when first sought.

Divide ,8746, by 9,6

$$\begin{array}{r} 9,6 \, ) \, ,8746 \, ) \, ,091 \\ \underline{864} \end{array}$$

$$\begin{array}{r} 106 \\ \underline{96} \end{array}$$

10

Divide                      by

## I N S T R U C T I O N.

In Division of Decimals you may either mark the Value of the first Figures arising in the Quotient at first, or after the whole Operation is done. If you go by the first Rule above, it should be wrought out ; if by the latter, which is thought the better Method, you may fix the Value thereof at first. As in the above Question I find the Divisor goes nine Times in the first three Figures of the Dividend ; which 9, when multiplied into the 9 the whole Number in the Divisor, I observe falls under the 7 in the Dividend : Therefore, as that 7 stands in the 2d Place of Decimals, I make the 9 in the Quotient of the same Denomination, by placing a Cypher before it, and then go on with the Question as in Common Division.

Di-

132 DECIMAL FRACTIONS.

Divide ,07643825, by 342

Divide 15, by 48,

Divide 74,1382 by ,1435



# DECIMAL FRACTIONS. 133



## The SINGLE RULE of THREE DIRECT in DECIMALS.

This Rule being done the same as the Rule of Three before taught, both in the Stating and Working needs no Explication.

### E X A M P L E S.

If 1,3 Yard of Cloth cost 13 s. 9 d. what will 48,8 Yards cost  
 9 d. = .75.                      s.                      Yds

If £ 1,3 : 13.75 :: 48,8  
                     48,8

11000  
 11000  
 5500

1,3 ) 671,000 ( 516,15.                      s.                      The Answer : Or £.   s.   d.  
      65                                              12

21                      1,80  
 13                      4

80                      3,20  
 78

20  
 13

70  
 65

5

### I N S T R U C T I O N.

In this Example, 13 s. 9 d. the second Term must be reduced to the Decimal of a Pound, or the 9 d. to the Decimal of a Shilling, before you can proceed Fraction-wise : And observe, that whatever Species the Fraction of the 2d Term is of, the Answer will always be of the same Species or Denomination ; and the whole Numbers being mark'd off, the rest of the Figures are only Parts of that Denomination.

If

## 134 DECIMAL FRACTIONS.

If a Hogsheaf of Tobacco weighing 4 Cwt. 3 qrs. 16 lb. cost

What will

of the same cost?

What will the Pay of  
per Man?

Men amount to at

How many Pieces of Cambrick, each Piece containing  
Yards      Quarters and      Nails, may I have for      at  
the Rate of 10,8 s. per Yard.



## ARITHMETICAL PROGRESSION.

In Arithmetical Progression, a Series of Numbers is compared with one another, so that the Difference, or common Excess among them is equal: Thus, 3, 6, 9, 12, 15; or, 30, 27, 24, 21, differing from each other by 3, called the common Excess, are Numbers in Arithmetical Progression.

Note, When the Number of Terms are odd, viz. 5, 7, 9, 11, 13, &c. the Double of the Middle Term will always be equal to the Sum of the first and last Terms, or to any two equally distant from the odd, or middle Term.

### C A S E I.

When the Number of Places, or Terms, and the common Excess, are given to find the last Number.

### R U L E.

Multiply the Number of Places, less one, by the Common Excess, and to that Product add the first Term, and that Sum will be equal to the last Number.

### E X A M P L E.

If in seven Numbers or Terms, the first be 9, and the common Excess 13, What will the last Number be?

### I N S T R U C T I O N.

To answer this, you are first to consider the Number of Places is 7, which, according to the Rule, call 6; then observe the common Excess is 13, which multiplied by 6, produces 78; to which, if you add 9 the first Term, you will have 87 for the Answer.

A Traveller set out from Newcastle, on a Journey for three Weeks; and the first Day he went                      Miles, the next the third                      &c. How many Miles did he go on the last Day?

# 136 ARITHMETICAL PROGRESSION.

## C A S E II.

When the first and last Terms, called the Extremes, and the Number of Terms are given, to find the Sum, or Total of all the Terms.

## R U L E.

Add the first and last Terms together, and multiply that Sum by half the Number of Places, or Terms ; and the Product is the Sum of all the Terms.

## E X A M P L E.

Suppose 9 Dozen of Eggs be placed in a streight Line, at a Yard Distance from each other, and the first a Yard from a Basket ; and a Person undertakes to gather them into the Basket ; by bringing one at a Time : How far will he have gone when he has gather'd in the whole ?

|                      |       |       |
|----------------------|-------|-------|
| Last Term*           | — — — | 216   |
| First ditto          | — — — | 2     |
|                      |       | <hr/> |
|                      |       | 218   |
| Half Number of Terms |       | 54    |
|                      |       | <hr/> |
|                      |       | 872   |
|                      |       | 1090  |
|                      |       | <hr/> |

11772 Yards the Anf.

which, divided by 1760, the Yards in a Mile will be 6 Miles and 3 Quarters nearly.

A Person that bought          Yards of Cloth, was to pay for the  
first Yard      for the second      for the third,      &c. increasing  
every Yard : I demand the Price of the whole.

G E O.

\* In this (and Questions of the like Kind) the first and last Terms must be considered as double.



## GEOMETRICAL PROGRESSION.

Geometrical Progression (or Proportion) is when a Series of Numbers differ from one another in a certain Ratio or Proportion, from having one common Multiplier, as 2, 4, 8, 16, 32, are Numbers in Geometrical Proportion, and differ by a double Ratio, as 2 is the common Multiplier among them, that is, each Number is two Times more than the foregoing one.

Geometrical Progression may be considered under two Heads first premising, that

If three Numbers be in Geometrical Progression, the Product of the Extremes is equal to the Square of the mean, or middle Term.

If four Numbers be in Geometrical Progression, the Product of the two Means will be equal to that of the two Extremes.

The Ratio is found by dividing any one of the Terms by that next preceding it.

### C A S E I.

The first Number and the Ratio given to find the last Number or Term.

### R U L E.

Multiply the first Number by the Ratio, and that Product again by the Ratio, or common Difference, and go on thus for 5 or 6 Terms; then multiply any of these Places by itself, and divide the Product thereof by the first Number, and that Quotient will be a Term double to the Number you took it from, wanting one Place.

### E X A M P L E.

*A* sold his Coat to *B*, which had just 20 Buttons upon it, for what the last Button would come to by doubling every Button with a Farthing; how much would *A* have to receive?

# 138 GEOMETRICAL PROGRESSION.

| Terms | 1 | 2 | 3 | 4 | 5  | 6  | 7  | &c. |
|-------|---|---|---|---|----|----|----|-----|
|       | 1 | 2 | 4 | 8 | 16 | 32 | 64 |     |

Then  $\frac{64}{64} = 7^{\text{th}} \text{ Term.}$

$\frac{256}{384}$

$\frac{4096}{64} = \text{the } 13^{\text{th}} \text{ Term, as the } 1^{\text{st}} \text{ Term is Unity.}$

$\frac{16384}{24576}$

$\frac{262144}{2} = 19^{\text{th}} \text{ Term.}$

$524288 = 20^{\text{th}} \text{ Term.}$

Or,  $546\text{ l. } 2\text{ s. } 8\text{ d.}$  the Answer.

## INSTRUCTION.

To solve this Question, first raise a few of the leading Terms ; then multiply the 7th by itself, which produces one doubly distant save one, that is the 13th Term. Now I consider how I am to come at the 20th Term the easiest Way : I therefore multiply the 13th Term by the 7th again, which produces the 19th ; for any Term in the whole Series multiplied by another will produce a Term equal to the Sum of those made use of save one. I then multiply the 19th by the 2d, which abating 1, produces the 20th as above.

CASE

## GEOMETRICAL PROGRESSION. 139

### CASE II.

The Ratio, or common Difference, and the last Number, being given, to find the Sum or Total of all the Terms.

### RULE.

Multiply the last Term, or Number, by the common Difference, or Ratio, and from that Product take the first Number; then divide the Remainder by the common Difference, less 1, and the Quotient is the Sum of all the Series.

A cunning Jockey sold a Horse to a Gentleman for the Price his Shoes would come to at a Farthing for the first Nail, and to double the Price of each Nail. Now as the Horse had Nails in his Shoes, I demand what his Price would be?

### INSTRUCTION.

Here you must proceed as in the former Case to find the Amount of the last Term; then as the Ratio is 2, you multiply by it, and from that Product deduct 1 the first Term; after that, what remains is to be divided by the Ratio, less 1, which in this Case is 2, so 1 from 2 leaves 1, which as it makes no Difference in dividing or multiplying by Unity, the former Number will be the Answer to the Question.

PER-



# PERMUTATION: Or, VARIETY OF CHANGES.

Permutation teaches us to find all the Variations or Changes any Number of Things are capable of going through.

## R U L E.

Multiply all the Numbers given together, that is, the first by the second, the second by the third, &c. till you have gone thro' all the Numbers, and the last Product will be the Variety of Changes.

## E X A M P L E.

I demand the Changes that may be rung on      Bells, or the  
different Positions      Persons may sit at Table ?





## S I N G L E   P O S I T I O N .

In this Rule we make Use of only one supposed Number, with which (according to the Nature of the Question) we work as if it was the true one, and from the Result thence arising, be it either too much, or too little, the true Number may be found by observing the following Proportion, viz.

As the Total arising from the Position

Is to the Position itself,

So is the given Number

To the true Number sought.

### E X A M P L E .

A Person being ask'd how many Guineas were in his Purse, answer'd, if the third, fourth, and fifth of them were added together, they would make 120 Guineas; I demand how many he had?

### O P E R A T I O N .

Suppose he had 210

|      |               |    |      |
|------|---------------|----|------|
| Then | $\frac{1}{3}$ | is | 70   |
|      | $\frac{1}{4}$ |    | 52,5 |
|      | $\frac{1}{5}$ |    | 42   |

Proof 153 2

|               |       |
|---------------|-------|
| $\frac{1}{3}$ | 51,06 |
| $\frac{1}{4}$ | 38,3  |
| $\frac{1}{5}$ | 30,64 |

120 Guineas.

If 164,5 : 210 :: 120

120

4200

210

164,5)25200(153,2 Anf.

*Note, See the Instruction in the next Page.*

Three Persons, *A*, *B*, and *C*, agree to buy a Ship worth and that *B* is to pay 40 *l.* more than *A*, and *C* 50 *l.* more than *B*; I demand how much each will have to pay?

## I N S T R U C T I O N .

Here I suppose he had 210 Guineas, and take  $\frac{1}{3}$ ,  $\frac{1}{4}$ , and  $\frac{1}{5}$  of that Number, and add together as the Question requires, which I find make  $164\frac{1}{2}$  Guineas, (the Half is thrown in a Decimal ,5). Then I say if 164,5 come from 210, what will 120: This Proportion I find produces 153,2, nearly, which is the Answer to the Question.



## DOUBLE POSITION.

In Double Position, we find the true Numbers fought by making Use of two supposed Numbers.

### R U L E.

Having placed the Errors opposite to their Suppositions, multiply them crosswise, that is, each Supposition into the Error of the other; and if the Errors are alike, that is, both greater, or both less than the given Number, take their Difference for a Divisor, and the Difference of their Products arising from the Multiplication crosswise for a Dividend; but if the Errors are unlike, that is, one too much and the other too little, take their Sum for a Divisor, and the Sum of their Products for a Dividend, and the Quotient will be the Answer.

### E X A M P L E.

Three Men would have 100*l.* divided among them, so as the second might have twice as much as the first, wanting 5, and the last three times as much wanting 10; I demand the first Man's Share, and also the Share of the other two?

|                   |       |                        |       |
|-------------------|-------|------------------------|-------|
| 1st Supposition   | 20    | 2d Supposition         | 15    |
| 2d Man would have | 35    | Then 2d Man would have | 25    |
| And 3d Man        | 50    | And the 3d Man         | 35    |
|                   | <hr/> |                        | <hr/> |
|                   | 105   |                        | 75    |

$$\begin{array}{rcl}
 1st\ Supposition & 20+5 & \times \quad 75 \\
 2d\ ditto & 15-25 & \quad 500
 \end{array}$$

Then  $30 \overline{)575}$  (19*l.* 3*s.* 4*d.* the 1st Man's Share.  
           33  6  8     2d Man's ditto.  
           47 10  0     3d Man's ditto.

£. 100   0   0 Proof.

A,

### I N S T R U C T I O N.

I here make Use of the Number 20, which I call my first Supposition, and go on with it as if it was the true Number, according

*A*, *B*, and *C*, bought a Quantity of Barley which cost  $l.$  of which *A* paid a certain Sum : *B* paid  $l.$  more than *A*, and *C* paid as much as *A* and *B* ; I demand each Man's Payment of the Whole ?

Three Men, as *A*, *B*, and *C*, bought a Quantity of Timber for  
 $l.$  *A* says to *B* give me half your Money and I will pay for it : *B* says to *C* give me one third of your Money and I will pay for it : *C* says to *A* give me one fourth of your Money and I will pay for it : I demand the Sum of Money each had ?

ing to the Nature of the Question. It produces 105, which is 5 too much, or makes an Error +5. Then I try 15 for the next Supposition, and go on with it as before : It produces only 75. I therefore say 15—25. Next I place the two Numbers or Suppositions, and their Errors, opposite to each other, and multiply each into the Error of the other, which produces 75 and 500 as above. Lastly, I consider that as the Errors are unlike, or the one too much and the other too little, they are to be added together, and also the Products of them, as the Rule directs, which make 30, and 575, these Sums divided one by the other gives 19  $l.$  3  $s.$  4  $d.$  for the Answer, or the first Man's Share. The Proof is easy.

EX-





# E X T R A C T I O N

## O F T H E

### S Q U A R E R O O T.

When any Number is multiplied by itself, the Product is called the Square of that Number, and the Number itself is called the Square Root of that Product; so that 3 multiplied by 3 gives 9; therefore 9 is the Square of 3, and 3 is the Square Root of 9; also 36 is the Square of 6, and 6 is the Square Root of 36, &c. In like Manner, every Number squar'd and multiplied again by itself, produces the Cube of that Number; as may be seen in the following Table, wherein the Squares and Cubes are placed together.

*A TABLE of SQUARES and CUBES, and their ROOTS.*

| Root. | 1 | 2 | 3  | 4  | 5   | 6   | 7   | 8   | 9   |
|-------|---|---|----|----|-----|-----|-----|-----|-----|
| Squ.  | 1 | 4 | 9  | 16 | 25  | 36  | 49  | 64  | 81  |
| Cub.  | 1 | 8 | 27 | 64 | 125 | 216 | 343 | 512 | 729 |

To extract the Square Root of any Number, you must,

1st, Begin at the Unit's Place, and make a Point or Period over it, and also over every second Figure.

2dly, Take the nearest less Square Root of the first Period towards the Left-hand, (which may be easily found by the foregoing Table) and place it like a Quotient Figure in common Division.

3dly, Subtract its Square from the said first Period, and to the Remainder bring down the next Period, or 2 Figures, and call that the Resolvend.

4thly, Double the Root or Quotient Figure, and place it for a Divisor on the Left-hand of the Resolvend; and seek how often  
T
the

# 146 EXTRACTION OF THE

the Divisor is contained in the Resolvend abating the Unit's Place; which Figure place in the Quotient, and likewise in the Unit's Place of the Divisor; then multiply this Divisor by the last Figure put in the Quotient, and subtract the Product from the Resolvend, (as in common Division) and so proceed to work in like Manner for each Period that is in the given Number.

Note, There must be just so many Figures in the Quotient, and so many Operations, as there are Points in the given Number.

## EXAMPLE I.

Let 2304 be a Number given, and let the Square Root thereof be required?

$$\begin{array}{r}
 \cdot \cdot \\
 23 \overline{) 04} \text{ ( 48 Root required.} \\
 \underline{16} \\
 88 \overline{) 704} \text{ Resolvend.} \\
 \underline{704} \text{ Product.} \\
 \dots
 \end{array}$$

## INSTRUCTION.

In the Example above, I first point the given Number as before directed, putting a Point upon the Units, and another upon the Hundreds; then I seek the greatest square Number in 23, which I find to be 16, 4 being the Root thereof; so that I place 16 under 23, the first Period, and 4 in the Quotient, then subtract 16 from 23, and there remains 7, to which Remainder I bring down the next Period, and place it on the Right-hand, which makes 704 for a Resolvend; then I double the Quotient 4, and it makes 8, which I carry to the Left-hand of the Resolvend for a Divisor, and seek how many Times 8 will go in 70, the Answer is 8, which I put in the Quotient, and also place it on the Right-hand of the Divisor, which makes it 88; then I multiply 88 by the 8, I put in the Quotient, and the Product is 704; which, subtract from the Resolvend, and nothing remains: So that the Work is done, the Square Root of 2304 being 48.

II. What

## II. Extract the Square Root of

## III. Extract the Square Root of

As a Remainder will mostly happen, you may find its Value by annexing Cyphers to it, two at a Time, and so run the Root into Decimals as far as you please.

When a mixt Number is given, that is, a whole Number and a Decimal together, the Decimal Places must always be made even, so that there may a Point fall upon the Units Place of the whole Numbers.

## IV. The

## 148 EXTRACTION OF THE

IV. The Plan of a square House contains                      Square Feet; I demand how many square Feet are contained in one of its Sides?

V. Supposing the Plan of a House to be exactly square, each Side of which contains                      Feet; I demand how many square Feet are contained therein?



To extract the Square Root of a Vulgar Fraction, reduce the Fraction to its lowest Term ; then find the Root of the Numerator for a new Numerator, and the Root of the Denominator for a new Denominator ; but when you cannot extract the Root of the Numerator and Denominator, the best Way will be to reduce it to a Decimal, and then to extract the Square Root thereof.

## EXAMPLES.

I. What is the Square Root of

II. What is the Square Root of

# E X T R A C T I O N O F T H E C U B E R O O T.

There are three Dimensions to be considered in a Cube, viz. Length, Breadth and Thickness, therefore to prepare the given Cube for Extraction, begin at the Units Place, and make a Point over every third Figure towards the Left Hand, and then proceed in the following Manner :

I. Seek the nearest Root of your first Period, and place it in the Quotient, then subtract the Cube thereof from the said Period, and to the Remainder bring down the next Period for a Resolvend.

II. The Resolvend is to be divided by 300 Times the Square of the Quotient Figure (or Figures) in order to discover its Root.

III. Multiply the said Divisor by the last Quotient Figure, placing the Product, thence arising, under the Resolvend.—Next multiply the Square of the last Quotient Figure, by the former Figure (or Figures) in the Quotient, and that Product again by 30, which place under the former Sum : Then cube the last Quotient Figure, and place that Number under the other two. Lastly, add all the three together for the Subtrahend, which subtract from the Resolvend, and the Work is done.

IV. If there be more Periods, proceed in the like Manner for each.—An Example with the Instruction following, will render this Rule both clear and easy.

## E X A M P L E I.

Extract the Cube Root of 46656 ( 36 Root, the Anf.  
27

|       |       |                           |
|-------|-------|---------------------------|
| 2700) | 19656 | Resolvend                 |
|       | 16200 | Div. mult. by 6.          |
|       | 3240  | Sq. of last Quo. Fig. &c. |
|       | 216   | Cube of the last Fig.     |
|       | 19656 | Subtrahend                |
|       | ..... |                           |

E X-

## EXTRACTION OF THE CUBE ROOT. 151

II. What is the Cube Root of

III. What is the Cube Root of

### INSTRUCTION.

After pointing the given Number, as before directed, I seek the greatest Cube Number in 46, the first Period, which I find to be 27, the Root thereof being 3, this I put in the Quotient, and the 27 under 46, then subtract 27 from 46, and there remains 19, to which Remainder I bring down the next Period 656, and annex it to 19, which makes 19656 for a Resolvend. — Then I square the Quotient Figure 3, which makes 9, and multiply it by 300, which gives 2700 for a Divisor; then how often 2700 the Divisor in 19656 the Resolvend, I say 6 Times, which 6 I put in the Quotient, and multiplied into the Divisor produces 16200; next I square the last quote Figure 6, which gives 36, and multiply it by the former quote 3, and by 30, which produces 3240; then the Cube of the last quote Figure 6, being 216, I add to the two Numbers above, and the Sum of all the three I call the Subtrahend, which is equal to the Resolvend.

Note, If the Subtrahend had been greater than the Resolvend, a less Figure must have been taken in the second Place in the Quotient.

IV. What

152 EXTRACTION OF THE CUBE ROOT.

IV. What is the Cube Root of

*fifty*

*R*

V. What is the Length, Breadth, and Height of a Wall that  
contains Cube Feet ?

To



## EXTRACTION OF THE CUBE ROOT. 153

To extract the Cube Root of a Vulgar Fraction,  
Extract the Cube Root out of the Numerator and Denominator,  
for a new Numerator and Denominator.

### E X A M P L E S.

I. What is the Cube Root of

II. What is the Cube Root of

Note, When a Decimal Fraction is given to be extracted, proceed as in whole Numbers, only care must be taken to prick off as many Decimals in the Root as you have Points over the Decimals.

U

M U L-



# MULTIPLICATION of FEET and INCHES

COMMONLY CALLED

## CROSS MULTIPLICATION.

Note, That

|            |          |           |
|------------|----------|-----------|
| 12 Inches  | } make { | 1 Foot.   |
| 12 Parts   |          | 1 Inch.   |
| 12 Seconds |          | 1 Part.   |
| 12 Thirds  |          | 1 Second. |
| 12 Fourths |          | 1 Third.  |

### GENERAL RULE.

Feet, multiplied by Feet, the Product is Feet.  
 Feet, multiplied by Inches, the Product is Inches.  
 Feet, multiplied by Parts, the Product is Parts.  
 Inches, multiplied by Inches, the Product is Parts.  
 Inches, multiplied by Parts, the Product is Seconds.  
 Parts, multiplied by Parts, the Product is Thirds.

### EXAMPLE I.

Multiply 8 Feet 6 Inches, by 4 Feet 5 Inches.

|        | Feet. | Inches. | Parts. |
|--------|-------|---------|--------|
|        | 8     | 6       | 0      |
|        | 4     | 5       |        |
|        | <hr/> |         |        |
|        | 34    | 0       |        |
|        | 3     | 6       | 6      |
|        | <hr/> |         |        |
| Answer | 37    | 6       | 6      |

### INSTRUCTION I.

First, I multiply the 6 Inches by 4, saying, 4 Times 6 is 24, that is 24 Inches, which is exactly 2 Feet; I therefore set down 0 under the Inches, and carry 2, saying 4 Times 8 is 32, and 2 that

## MULTIPLICATION OF FEET, &c. 155

that I carry, is 34, which I set under Feet; then I begin with 5 Inches, and say 5 Times 6 is 30 Parts, which is 2 Inches and 6 Parts, (for 30 divided by 12 quotes 2, and 6 remains) I therefore set down 6 under Parts, and carry 2, saying 5 Times 8 is 40, and 2 that I carry is 42 Inches, which, divided by 12, gives 3 Feet 6 Inches, which I set down, and add all up together; the Product, 37 Feet, 6 Inches, and 6 Parts, is the Answer.

### EXAMPLE II.

|                | Feet. | Inches. | Parts. | 2ds. | 3ds. |
|----------------|-------|---------|--------|------|------|
| Multiply<br>By | 13    | 7       | 4      |      |      |
|                | 4     | 6       | 5      |      |      |
|                | 54    | 5       | 4      |      |      |
|                | 6     | 9       | 8      |      |      |
|                |       | 5       | 8      | 0    | 8    |
| Answer         | 61    | 8       | 8      | 0    | 8    |

### INSTRUCTION II.

In this Example, I begin to multiply by the 4 Feet, saying 4 Times 4 Parts make 16 Parts, or 1 Inch 4 Parts; then 4 Times 7 Inches make 28, and 1 carried, is 29 Inches, or 2 Feet 5 Inches; then again, 4 multiplied into 13 Feet, make 52, and 2 carried is 54, which I set down, and have done with the Feet. Next I begin with the 6 Inches, and say, 6 Times 4 Parts make 24 Seconds or 2 Parts, according to the Rule; then 6 Times 7 Inches make 42 Parts, and two carried is 44, or 3 Inches 8 Parts; then again, 6 Times 13 is 78, and 3 carried is 81 Inches, or 6 Feet 9 Inches, which I set down; then I begin with the 5 Parts, and say, 5 Times 4 Parts make 20; which 20, according to the Rule, is but 20 Thirds, or 1 Second, 8 Thirds; I therefore set down 8 Thirds two Removes from the Place of Parts, and go on, saying, five Times 7 Inches make 35 Seconds, and one I carried is 36 or 3 Parts, setting down a Cypher in the Second's Place; then I say, 5 Times 13 Feet make 65, and 3 carried is 68 Parts, or 5 Inches 8 Parts, which I set down: And lastly, I add all up together, and the Total is the Answer to the Question.

III. Mul-

# 156 MULTIPLICATION OF FEET, &c.

III. Multiply  
Inches.

Feet

Inches by

Feet

IV. Multiply  
Feet

Feet  
Inches

Inches  
Parts.

Parts by

Note, When there are more than 12 Feet in the Multiplier, it may do as well to multiply the Feet in the Multiplicand by the Feet in the Multiplier, and then take the aliquot Parts for the Inches, &c. as may be seen in the next Example.

V. Let



# Or CROSS MULTIPLICATION. 157

V. Let 96 Feet 4 Inches be multiplied by 18 Feet 3 Inches.

|               | Feet. | Inches. |
|---------------|-------|---------|
| $\frac{1}{4}$ | 96    | 4       |
| $\frac{1}{3}$ | 18    | 3       |
|               | <hr/> |         |
|               | 768   |         |
|               | 96    |         |
|               | 24    | 1       |
|               | 6     | 0       |
|               | <hr/> |         |
| Answer        | 1758  | 1       |
|               | <hr/> |         |

VI. Multiply Feet Inches by Feet Inches.

## I N S T R U C T I O N.

In this Example, because there are more than 12 Feet in the Multiplier, I first multiply the Feet one by the other, then take the aliquot Parts of 3 Inches, which I find to be the fourth of a Foot ; therefore I divide 96 Feet 4 Inches by 4, and it gives 24 Feet 1 Inch ; next I take the aliquot Part of 4 Inches, which I find to be a Third ; therefore I divide 18 Feet by 3, which gives 6 Feet, (not meddling with the 3 Inches, because that was multiplied into the 4 before) ; then add all these together, and the Sum is 1758 Feet 1 Inch, the Answer.

Note, If Parts are given to be multiplied along with Feet and Inches, work in every Respect in the same Manner, only Regard must be had to the Product, which must be a twelfth Part less than when you multiply by Inches.

VII. Mul-

# 158 MULTIPLICATION OF FEET, &c.

VII. Multiply      Feet      Inches by      Feet  
Inches.

VIII. Multiply      Feet      Inches      Parts by  
Feet      Inches      Parts.

MEN-



# M E N S U R A T I O N.

It may not be amiss after Cross Multiplication to give an Example in each Sort of Artificers Work, relating to Buildings, and to shew the different Ways of Measuring according to the Custom of each Trade, as some give the Content in Feet, some in Yards, some in Squares, some in Rods, &c. and first to begin with

## B R I C K L A Y E R S   W O R K.

Bricklayers commonly measure their Work by the Rod Square, of 16 Feet and a half, so that one Rod in Length, and one in Breadth, contain 272,25 square Feet; but for common Practice, 272 Feet only are sufficient.

All Sorts of Brickwork are reduced to the Standard of  $1\frac{1}{2}$  Bricks thick, by the following Rule.

RULE. Multiply the Number of superficial Feet contained in the Wall, by the Number of Half-bricks which it is in Thickness; one third Part of that Product shall be the Content thereof in Feet, when reduced to standard Thickness. Then divide by 272, the Quotient gives the Square Rods, and the Remainder the Feet, or Parts of a Rod.

### E X A M P L E   I.

If a Garden Wall be 320 Feet in Length, and 6 Feet 8 Inches high, and  $2\frac{1}{2}$  Bricks thick, how many Feet of Brick Work are contained therein?

| F.    | In. |          |
|-------|-----|----------|
| 320   | 0   | Length.  |
| 6     | 8   | Heighth. |
| <hr/> |     |          |
| 1920  |     |          |
| 213   | 4   |          |
| <hr/> |     |          |
| 2133  | 4   |          |
|       | 5   |          |
| <hr/> |     |          |

Divisor 3 ) 10666,66 ( 3555,555 F. The Answer in Feet.

## E X A M P L E II.

If a Brick Wall be                      Feet about, and                      Feet high,  
and                      Bricks thick ; I demand how many Rods are contain-  
ed therein ?

N. B. In measuring the Gavel, or Peak Ends of Buildings, they take half the Height thereof in the Middle to the Level with the Side Walls, which multiplied into the whole Breadth of the Wall, gives the Content.

## I N S T R U C T I O N.

\* Here first set down the Length of the Wall, and the Height of it under; then multiply them together by Cross Multiplication, as before directed.—Next multiply that Product by the 5, the Number of Half-bricks, the Thickness of the Wall, given : Here it must be observed, that in multiplying by the 5, five Times 4 make 20, which (in this and the like Cases, as 12 Inches make a Foot) must be reckoned 1 Foot and 8, therefore 8 is set down under Inches, and 1 carried to the Feet, which being also multiplied by 5, produce 10665, and 1 carried 1066. Now the 8 Inches being 10 be reckoned 2-thirds of a Foot, is thrown into a Decimal before the Feet is divided by 3, so that the Feet will stand thus, viz. 10666,666, which divided by 3 quote 3555,555, and that Sum again divided by 272, rejecting the Decimal, gives 13 Rods, 19 Feet, which with the Value of ,555 of a Foot before rejected, gives 13 Rods, 19 Feet, and 79 Inches for the Answer.

*Note,* When Feet and Inches are to be multiplied or divided by Numbers of different Denominations with themselves, it will be found the better Way to throw the Inches into Decimals at first, than to proceed by Cross Multiplication.



## 161

Plastering, Rendering and Cieling, are all measured by the Square Yard, so that when a Room is plastered or rendered, take its Compass in the Inside, Gutting in Chimnies, &c. where the Work comes, and multiply it by the Height, gives the Content.

If the Compals of a Room be                      Feet, and its  
Height                      Feet, how many Square Yards are in it ?

Joiners measure their Work by the Square Yard ; but in taking the Height of any Room where there is a Cornish about, and swelling Pannels and Mouldings, they with a String, begin at the Top, and girt over all the Mouldings, which will make the Room to measure much higher than it is ; and for measuring about the Room they only take it as it is upon the Floor.

If a Room of Wainscot (being girt over the Mouldings) be  
Feet Inches, and the Compass thereof  
Feet Inches; how many Square Yards are therein?

Note, That Whitening and Colouring are both measured by the Yard as Plaistering.

O F

## OF MASONS WORK.

Masons Work is sometimes measured by the superficial Foot, and sometimes by the Foot solid, and in some Places they measure their Walling by the Rod of 63 Square Feet.

## E X A M P L E.

If a Wall be                      Feet                      Inches long, and  
Feet                      Inches high, and                      Feet                      Inches thick ;  
how many solid Feet are contained in the Wall ?

*To Measure* BOARDS *and* Flat TIMBER.

If the Board be regular, the Rule to find the Content in Feet, is, to multiply the Length in Inches by the Breadth in Inches, and to divide by 144, or to multiply the Length in Feet by the Breadth in Inches, and divide by 12, gives the Answer.

## E X A M P L E.

A Board that is                      Feet                      Inches long, and  
Feet                      Inches broad ; how many Feet doth  
it contain ?

Note, When a Board is wider at one End than the other, the common Way is to add the Breadth of the Ends together, and to take the Half for a mean Breadth, which multiplied into the Length, gives the Content,

The

The Contents of Boards or flat Timber may be readily found by the Help of the following Decimal Table, which shews the Length of one Foot in Inches and Parts, at all Breadths from one to 36 Inches.

*A TABLE for Flat Measure.*

| <i>In.</i> | <i>Inches</i> | <i>In.</i> | <i>Inches</i> |
|------------|---------------|------------|---------------|
| <i>Br.</i> | <i>long.</i>  | <i>Br.</i> | <i>long.</i>  |
| 1          | 1.4           | 19         | 7.57          |
| 2          | 72            | 20         | 7.2           |
| 3          | 48            | 21         | 6.85          |
| 4          | 36            | 22         | 6.54          |
| 5          | 25.8          | 23         | 6.26          |
| 6          | 24.           | 24         | 6.            |
| 7          | 20.57         | 25         | 5.76          |
| 8          | 18.           | 26         | 5.53          |
| 9          | 16.           | 27         | 5.33          |
| 10         | 14.4          | 28         | 5.14          |
| 11         | 13.09         | 29         | 4.96          |
| 12         | 12.           | 30         | 4.8           |
| 13         | 11.17         | 31         | 4.64          |
| 14         | 10.28         | 32         | 4.5           |
| 15         | 9.6           | 33         | 4.36          |
| 16         | 9.            | 34         | 4.23          |
| 17         | 8.47          | 35         | 4.11          |
| 18         | 8.            | 36         | 4.            |

**RULE.** Bring the Length into Inches, and divide by the Number in the Table opposite to the Breadth in Inches.

### E X A M P L E.

If a Plank be 30 Feet long and 18 Inches broad, how many Feet of Timber are in it?

$$\begin{array}{r} 30 \\ 12 \\ \hline \end{array}$$

$$8)360($$

Answer 45 Feet.

### E X A M P L E II.

If a Board be Inches at one End, and  
Inches at the other End, and Feet long: What is  
the Content?

$$\begin{array}{r} 25 \\ 16 \\ \hline 210 \\ 25 \\ \hline 12 \overline{)460} \\ 38-4 \end{array}$$

# MENSURATION: OF CARPENTERS WORK.

Carpenters Work, as Flooring, Partitioning and Roofing, are measured by the Square of 100 Square Feet, like Tiling, and in some Places by the Square Yard.

## E X A M P L E.

If a Floor be                      Feet long, and                      Feet broad, how many Squares are in it ?

How many Deals                      Feet long, and                      Inches wide  
will floor a Room                      Feet long, and                      Feet wide ?



## OF TILING AND SLATING.

Tiling is measured by the Square of 100 Feet; Slating sometimes by the Yard Square, and sometimes by the Square Rod of 49 Square Yards, &c. The Way to measure both, is to measure along the Ridge of the Building, with a Line for the Length, and then having a small Weight at one End of a Line, put it over the Ridge, and let it go down to the Eave, and take the other End to the other Eave, so have you the Breadth of the Roof; where observe, that double Measure is commonly allowed for Hyps, Vallies, Gutters, &c. In Tiling it is usual to allow double Measure at the Eaves, so much as the Projecture is over the Plate, which is commonly about 18 or 20 Inches.

## E X A M P L E.

If the Breadth of a Building's Roof with the usual Allowance at the Eaves be                      Feet, and the Length along the Ridge Feet, how many Square Yards, Squares, and Rods, are in that Roof?

## OF PAINTERS WORK.

Painters' Work is the same with Joiners, both in taking Dimensions and Measure.\*

## E X A M P L E.

If a Room be painted, whose Height is                      Feet  
Inches, and                      Feet                      Inches about ; how many  
Square Yards ?

## OF GLAZIERS WORK.

Glaziers measure by the Foot Square, and are more exact in taking their Dimensions, for they frequently take to a Quarter of an Inch ; and here take Notice, that all Curv'd-lin'd Windows, as Rounds, Ovals, Arches, &c. are measured as if they were full Square, viz. the greatest Length and Breadth taken and multiplied together, on account of Labour and Waste of Glass.†

## E X A M P L E.

If there be                      Panes of Glass each                      Feet                      Inches,  
and                      Parts high, and                      Feet                      Inches, and  
Parts broad ; how many Square Feet are contained therein ?

\* Note, That Doors, Window-shutters, and all such Works as are wrought on both Sides, are called Work and Half-work : In all such Cases find the Content as before, and then take half that Content, and add to itself, so have you the Content of Work and Half.

† Note, That Window-Lights, Window-Bars, Casements, and such like Things, are done at so much per Piece.



## SOLID MEASURE.

To measure square Solids, whose Bases are equal,

The Rule is, multiply the Length, Breadth, and Depth or Thickness into each other ; and if Inches, divide by 1728, the Quotient gives the Content.

## E X A M P L E.

A Stone of Feet Inches long, Feet Inches broad,  
Feet Inches deep : I demand how many Feet there are  
contain'd in the said Stone ?

To measure square Solids, whose Bases are unequal.

RULE. Multiply the Areas of the two Bases together, and to the square Root thereof add the two Areas, that Sum multiplied by one third of the Heighth, gives the Content.

But the common Way is to take  $\frac{1}{2}$  the Sum of the two Breadths at the Ends for a mean Breadth, and also half the Depths at the Ends for a mean Depth, which multiplied together gives the mean Area, and that multiplied into the Length gives the Content.—Some take half the Sum of the Breadth and Depth at the Middle of the Tree for the Side of a mean Square.

Y

E X-

## E X A M P L E.

Suppose a Piece of Timber, the Side of whose Square is  
 Inches at the greater End, and                      Inches at the lesser End,  
 and                      Feet long; What is the Content?

To measure Round Timber whose Bases are equal.

The common Way is to take the Circumference of the Tree in the Middle, with a String, and then take the fourth Part of that Circumference for the Side of a mean Square, which squared, and multiplied by the Length, gives the Content; but to be more exact, multiply the Number ,07958 by the Square of the Circumference, then multiply that Product by the Length; cut off five Figures for the Decimal, and the remaining Figures towards the left Hand are the Content.

## E X A M P L E.

If a Piece of round Timber be                      Feet                      Inches  
 long, and                      Inches in Circumference; how may solid Feet  
 are contained therein?



To measure Round Timber whose Bases are unequal, as Tapering Timber, &c.

The Rule is, subtract the Diameter of the less Base from the greater, and square the Difference, then add one third thereof to the Product of the two Diameters; that Sum multiplied by ,7854 will be the mean Area, which multiplied into the Length gives the Content.

## E X A M P L E.

If the Diameter of a Piece of Timber, at one End, be  
Inches, and at the other                      Inches; the Length thereof be-  
ing                      Feet; how many Feet of Timber will it contain?

Note, In measuring both square and round Timber, the common Way is to take a fourth of the Girt at the Middle of the Piece to be measured, for the Side of a Square, which multiplied by itself, and then into the Length of the Piece, gives the Content in Inches generally, which may be reduced into Feet by dividing by 1728.—But Tradesmen generally cast up the Contents after this Method, by a Sliding-Rule contrived for the Purpose, by which, if the Length in Feet upon the Slide be set to the gauge Point 12 (as 'tis called) on the Girt Line; then opposite to the Girt of the Piece the Slide shews the Content in Feet and Parts. This Method is considerably short of the Truth, and greatly in Favour of Purchasers.



## Of SURVEYING: Or, LAND MEASURING.

**I**N order to measure large Tracts of Land, as Commons, or large Inclosures, with any tolerable Degree of Exactness, the Surveyor should be provided with several curious and valuable Instruments, such as a Plain-Table with double Sights, a Theodolite, Protractor, Parallel Ruler, and a Case of small Instruments, with a Scale of equal Parts, good Dividers, Steel Pens, &c. as also a good Chain. Yet as to survey a small Field, or so, may be of Service to some, that may be performed by the Help of the Chain only. All Land is measured by a Chain of 4 Rods, or 22 Yards, in Length, according to an Act of the 33 of Edward the First, in the Year 1305, which says, that a square Acre shall contain 160 Rods, or 160 Rods in Length and 1 in Breadth, make an Acre of Land; or which is more easy and the common Way, 10 Chains in Length, and one Chain in Breadth, make a Statute Acre of Ground.

The Chain as before observed, is 22 Yards in Length, and contains just 100 Links (each Link being 7,92 Inches, or nearly 8 Inches.) The Chain is also divided into 10 equal Parts at every 10 Links, by a Mark of Brass, in order to count the Links more readily in the Measurement of such Lines as make a broke Chain at the End. Thus it appears, that as 10 Chains in Length and 1 in Breadth, or 10 in Breadth and 1 in Length, make an Acre, there will be just 100,000 square Links contained in an Acre; and from hence arises the most easy Rule for calling up all Surveys, viz.

### GENERAL RULE.

Multiply the Chains and Links in Length by the Chains and Links in Breadth, and from the Product cut off five Figures, then those Figures to the Left-hand of the Point will be Acres; and the five cut off, first multiplied by 4, and then by 40, give the Roods and Perches, marking five Figures each Time for Decimals to the Right-hand.—And

In

## E X A M P L E S.

I. Suppose the Figure following, marked A, to be a Field, the Length of which is 9 Chains, 80 Links, and the Breadth 4 Chains; how many Acres, Roods and Perches are contained therein?

## O P E R A T I O N.



|         |   |          |
|---------|---|----------|
| Length  | — | 980      |
| Breadth | — | 400      |
|         |   | <hr/>    |
|         |   | 3,92000  |
|         |   | 4        |
|         |   | <hr/>    |
|         |   | 3,68000  |
|         |   | 40       |
|         |   | <hr/>    |
|         |   | 27,20000 |

~~Answer 3.3.27~~  
INSTRUCTION.

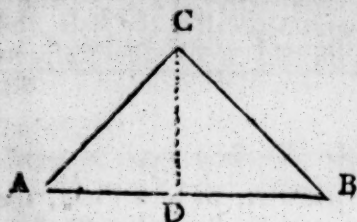
# I N S T R U C T I O N.

To measure a regular Field in the above, or like Form, only the Dimensions of the Length and Breadth, or of two Sides thereof, need be taken.

II. Suppose a Field be in the Form of the following Figure  
 A B C ; and if from A to B measure 19 Chains, 25 Links ;  
 from A to C, 11 Chains, 40 Links ; from C to B, 12 Chains,  
 40 Links ; and from C to D, 9 Chains, 20 Links ; how many  
 Acres are contained therein ?

O P E.

## O P E R A T I O N.



A B, whole Base of both Triangles.

Length of the Base A B                      1925  
 Half C D, Perpend. to both                      460

115500  
 7700

8,85500  
 4

Ac. Ro. Per.  
 Answer 8    3    16

3,42000  
 40

16,80000

☞ The Lines A C, and C B, are here of no Use in finding the Contents of the Field, yet they are measured to come at the Figure of the Field with more Exactness ; for in all Triangles of what Sort soever, if one of the Sides be laid down upon Paper, and the Lengths of the other two set off from each End of the said Line with a Pair of Compasses, making a small Arch therewith, the Point where the said Arches meet will determine the Form of the Triangle.—The Length of such Lines may be taken from any Rule of equal Parts.

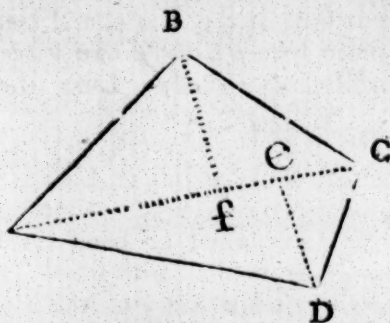
## I N S T R U C T I O N.

Here it must be considered, that as this is a double Triangle the Surveyor will be obliged to measure a Line from the Point or Corner C to cut the Line A B exactly square ; this he may do pretty well by his Eye either at the Corner C, or by laying his Pole across the Chain in measuring the Line A B. This done, it reduces the Figure to two Triangles, the two shortest Sides of each making a square Corner, commonly called a Right Angle. And it must be observed, that all Fields that are not in exact Squares, or long Squares, must be reduced into such Triangles before the Contents thereof can be known, except where two Triangles are taken together, as in this and the like Cases.

III. Admit a Field, or Inclosure to have four unequal Sides like the following Figure, called a Trapezium ; and suppose the Line A



A C, which runs across the whole Field (commonly called a Diagonal Line) measure 2176 Links, and the short Lines B f and D e, which fall square upon it, called Perpendiculars, be 1096 and 684; how many Acres, &c. are in that Inclosure ?



|                    |          |
|--------------------|----------|
| Whole Diagonal A C | 2176     |
| Half B f           | 548      |
|                    | <hr/>    |
|                    | 11,92448 |
|                    | 4        |
|                    | <hr/>    |
|                    | 3,69792  |
|                    | 40       |
|                    | <hr/>    |
|                    | 27,91680 |

|                    |      |
|--------------------|------|
| Whole Diagonal A C | 2176 |
| Half D e           | 342  |

|          |
|----------|
| 7,44192  |
| 4        |
| <hr/>    |
| 1,76768  |
| 40       |
| <hr/>    |
| 30,70720 |

|                  |     |    |    |
|------------------|-----|----|----|
|                  | Ac. | R. | P. |
| Content of A B C | 11  | 3  | 27 |
| Ditto of A C D   | 7   | 1  | 30 |

Ditto of the whole Field 19 1 17 The Answer.

## I N S T R U C T I O N.

Here the Content of each Triangle is found as in the last Question, and then added together to make up the Content of the whole Field. If the Field had been more irregular, it must have been divided into more Triangles, and the Contents of each would have been to be cast up by itself, and then added to the rest. The Form of this Field may be obtained by measuring only the Diagonal A C, and the two Perpendiculars B f and D e; or having the Length of the Diagonal and of the Hedges all measured round, by proceeding as in the last Example for each Triangle, which is much the better Way.

O B.

## OBSERVATIONS.

1. To set off any Angle or Corner that may be wanted to lay down the Figure of a Field or two: First measure a Chain or two each Way, i. e. along each Hedge or Side of the Angle, and mark the Places; then measure the Distance between those two Places, from which the Angle may be readily constructed, a Line being first drawn for one of the Hedges.

2. Surveyors generally make Use of a Pole of just 10 Links (or  $2\frac{1}{2}$  Yards) in Length, which they take in their Hands to measure the Off-sets with when the Hedges are crooked or bend much. Those Corners or Bendings are all to be thrown into small Triangles in casting up the Contents. The main Body of the Field is measured by streight Lines, and thrown generally into Trapeziums, or large Triangles, as in the former Examples.

3. In taking Off-sets with the Pole, lay it across the Chain as exactly square as possible, and observe to go in a streight Line to the Place to which it points.

4. In taking Off-sets, great Care must be taken to mark down the Chains and Links each Off-set is taken at upon the principal or Station Line.

5. To measure a Line streight, all possible Care must be taken to observe always that the Person who leads the Chain stands directly in a Line with the Place you want to measure to, before he be suffered to put down a Stick; one such Mark or Stick he must leave for you to take up at every Chain End, and be so directed to place it streight in the Line before he goes forward.

6. In measuring across the Ridges of Grounds that have been made very round in the Ploughing, Care must be taken that the Chain be pulled pretty streight at every Length, to prevent such Lands being measured to too much.

In dry Weather, some ingenious Farmers and Husbandmen can make a Cord supply the Place of a Chain with tolerable Exactness; and in such Cases they put a Mark upon the Cord at every ten Links.—In wet Weather a Cord will run up.

92 12 - 2

20  
1852  
12

2234  
4

00004



*Reuter*

b  
c, c  
f

1044  
20  
20

2524  
4  
10002

